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THE WILSON BULLETIN

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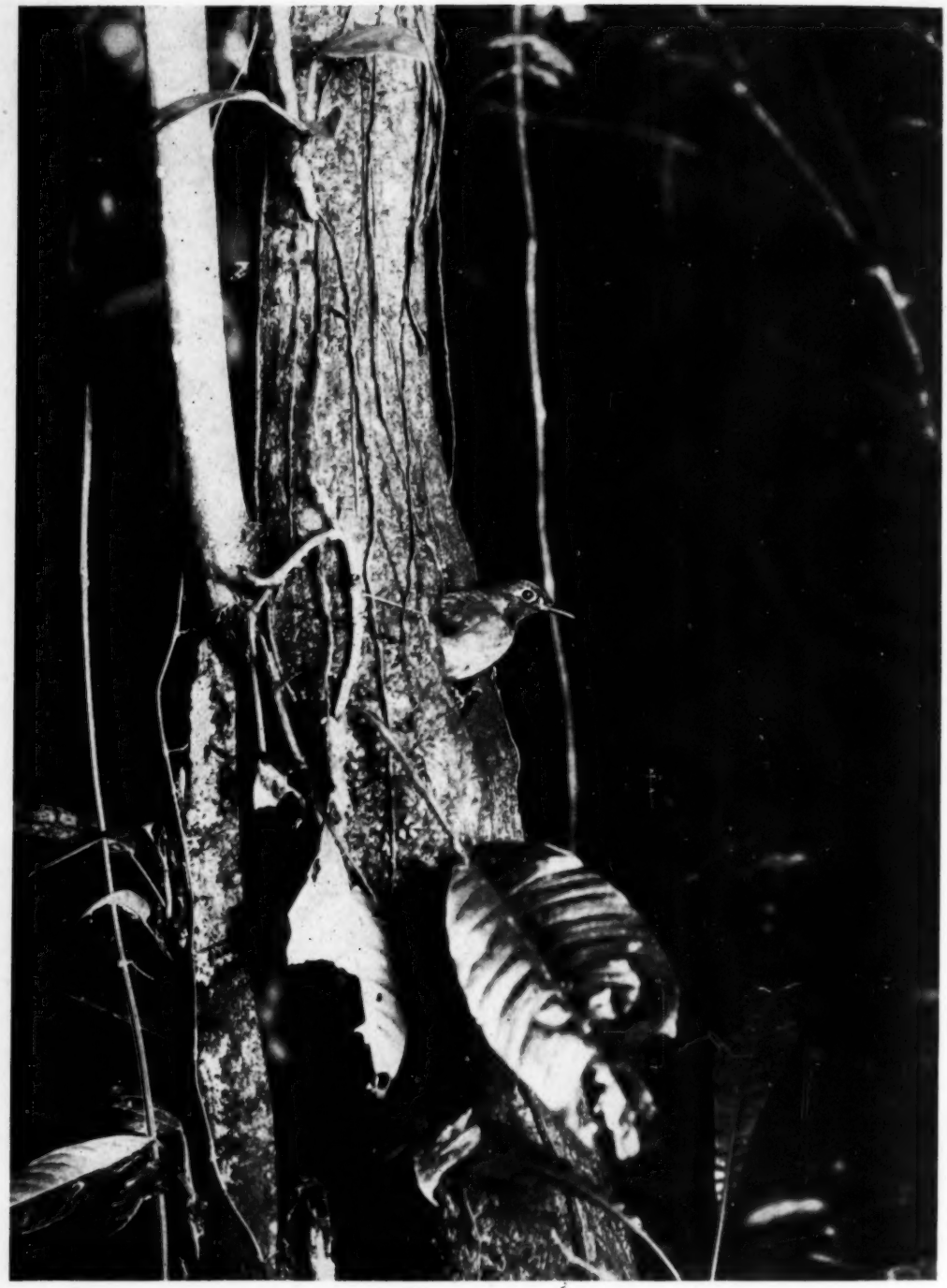

PANAMA ANT-THRUSH
(Formicarius analis panamensis)

At nest on Barro Colorado Island, Canal Zone, May 19, 1929. The nest was three feet above the ground and contained one egg. Flashlight photograph by Howard H. Cleaves.

THE WILSON BULLETIN
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NOTES ON THE LIFE HISTORY OF THE EMERALD TOUCANET

BY HELMUTH O. WAGNER [1]

THREE representatives of the Ramphastidae occur in Mexico. Of these the Emerald Toucanet (*Aulacorhynchus prasinus*) [2] has the widest distribution as well as the most northerly range. It is distinctly a bird of the virgin forest. In southern Mexico I encountered the Emerald Toucanet only in the mountains between 1,000 and 2,500 meters (3,280 and 8,200 feet), never at lower altitudes, even where apparently suitable habitats were available. Farther north in Mexico one finds it at lower altitudes and in much drier habitats. Obviously, then, its ecological requirements are not the same in all parts of the country, and the observations recorded below, which were made in the south of Mexico, are valid only for that region.

Observation Area

My observations of the Emerald Toucanet were made close to the Guatemalan border, in the state of Chiapas, during several lengthy visits in the course of the last 10 years (1933 to 1942). I observed the bird at all seasons of the year, sometimes almost daily.

Along the Pacific coast runs a chain of mountains, the Sierra Madre de Chiapas, an extension of the South American Cordillera. In my observation area, near Mapastepec (a railway station between Tonala and Tapachula), these mountains rise to an altitude of 2,300 meters (7,544 feet). Here the continental divide is at some places no more than 10 miles from the Pacific.

I made observations on both the Atlantic and the Pacific slope of the mountains. Extensive undisturbed virgin forest is the habitat required by the Emerald Toucanet in Chiapas. The bird does not occur where the forest gets drier, as is the case, for example, on the Pacific slope below 1,000 meters (3,280 feet).

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[1] Translated by Margaret and Ernst Mayr.

[2] The Emerald Toucanet was portrayed in color by George Miksch Sutton in an earlier *Bulletin* (Sutton and Burleigh, 1940).—Ed.

Figure 1 illustrates the local conditions in Chiapas—the vegetation zones and the distribution of the Emerald Toucanet at different seasons. The breeding range is in the high mountains in typical cloud forest. Its lower borders are at altitudes of about 2,000 meters (6,560 feet) on the Pacific slope, and 1,750 to 1,800 meters (5,740 to 5,904 feet) on the Atlantic slope. The birds spend most of the time between breeding seasons at lower altitudes. They are found on both slopes of the mountains, but the flocks are much more numerous on the Atlantic side, where the humidity is higher. On the Pacific slope, I have found them only at the bottom of humid valleys.

Climate of the Habitats

Sharply defined dry and rainy seasons alternate in most parts of Chiapas. The beginning and length of these seasons vary from year to year by several weeks, but the rainy season usually extends from the middle of May to October. At an altitude of 1,000 meters (3,280 feet) on the Atlantic slope, the average yearly rainfall (taken over seven years) was 390 cm. (153 inches). At the end of October the heavy rains stop, the sun begins to shine, and both dryness and temperature begin to increase steadily. In April and May, temperatures of 30° and 35° C. are recorded at the local weather station (which is not, however, within the virgin forest).

The climate of the higher altitudes is quite different: there is a pronounced rainy season between May and October, but during the other months, when it is hot and dry at lower altitudes, it is still cold and rainy here. Cold northerly winds from the Gulf of Mexico drive rainclouds against the mountains above an altitude of 1,800 meters (5,904 feet), and these precipitate continual light rains. Thus one cannot speak of a dry season in the higher altitudes, especially in the wide mountain valleys. Unfortunately, I cannot give a figure for the annual rainfall here, but in spite of the fact that rain falls the year round, the annual total is probably less than at lower altitudes, where there is sometimes more than 12 cm. (5 inches) rainfall in 24 hours.

The difference in the climate of the two habitats of the Emerald Toucanet finds its most conspicuous expression in their dissimilar plant associations. In the breeding area, the invariably damp rainforest, large oaks are the prevailing tree. Beneath their high, widespreading crowns is only a spare undergrowth, among which large tree ferns are conspicuous. Every bough and twig is covered with a thick water-soaked layer of moss. On the great horizontal boughs of the oaks, 50 meters (164 feet) or more above the ground, there are luxuriant growths of orchids, ferns, and other epiphytes.

The virgin forest at lower altitudes, where pronounced dry and rainy seasons alternate, has a quite different aspect. This forest, too, is luxuriant, and because of the high temperatures, especially quick-

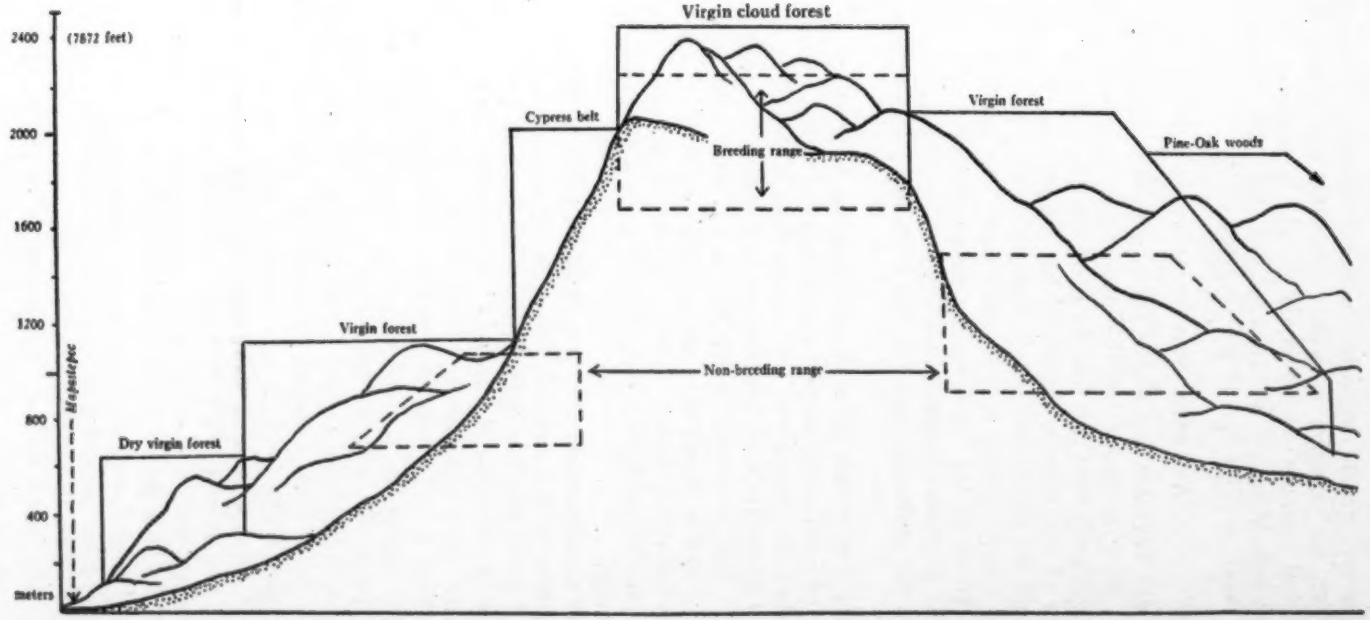

Figure 1. Diagrammatic cross-section through the range of the Emerald Toucanet in the Sierra Madre de Chiapas near Mapastepec, Chiapas, Mexico. The breeding range (Nov./Dec.-May/June) and non-breeding (summer) range are indicated by broken lines.

growing. However, plants requiring uniform moisture throughout the year, which are common at higher altitudes, are lacking here. Distinct seasonal changes are apparent in the appearance of the vegetation, whereas at higher altitudes, only a few miles distant, the same general aspect is preserved all the year round.

Vertical Movements

The Emerald Toucanet in Chiapas shows a limited adaptability to environment. After extensive observations and comparisons, I have come to the conclusion that it is less the plant associations than a very definite degree of atmospheric humidity that determines the sporadic distribution and the migrations there—changes in temperature and in available food supply playing only a minor part. The seasonal migrations of the Toucanet are regulated by seasonal fluctuations in the humidity of the air; also whenever there is a marked departure in either direction from the optimum humidity, the birds react by a temporary emigration.

The threshold at which the migratory impulse is released can be accurately determined: emigration from the always humid rain forest takes place when the atmosphere has become saturated with moisture, and raindrops on leaves and branches do not evaporate even when the rain stops. The Toucanets, which live in the dense tree tops, apparently dislike to stay in the continuously dripping foliage, and they leave the area for relatively dry places. Mature males and yearlings of both sexes precede the mature females, which are still busy with the care of the young.

I saw this demonstrated with remarkable clarity in May, 1942. On May 24 I crossed the mountains in splendid weather on my way to the coast. I heard the Toucanets in the dense treetops at a number of spots in the breeding range. When I returned the same way two days later, there was a pronounced change in the weather. The wind was blowing cloud shreds down the slope to the 1,000-meter (3,280-foot) level, and higher up I found myself in dense clouds. When I reached the cypress belt, with its light stands of pines and cypresses, a flock of Toucanets suddenly passed me in the fog, rushing downhill. A second and third flock followed. Beyond the continental divide, at 1,500 meters (4,920 feet), I met another flock, of five or six Toucanets, and later, a flock of more than ten. All these birds were leaving their breeding range, not to return until six months later. I approached the last flock to within five to seven meters, and could tell by the size of the bills that it did not include any young of the year. This is the only time I ever observed such a mass migration of these toucanets. Usually the migration occurs by degrees, probably according to individual variation in the reaction threshold.

The Toucanets return to the high mountains at the beginning of the dry season in November. This return migration occurs when a

certain degree of aridity is reached, which has its visible expression in a conspicuous change in the vegetation's appearance, particularly on the drier slopes. A few flocks linger in deep valleys at about 1,300 meters (4,264 feet), which are more humid because they are surrounded by mountains, and it happens sometimes that flocks of yearlings remain throughout the year at such places.

I have frequently observed that birds in general show a tendency to form larger groups in bad weather. This is also true of the Emerald Toucanet. The small flocks, which roam through the forest in the summer months, gather at the end of August into larger units of up to 20 birds. In September and October, when the soil and atmosphere are saturated with moisture even at the lower altitudes, so that there is no escape for the Toucanets into favorable environments, one finds the species usually on the crests of the mountains, where the foliage dries more quickly. But if during these months there are days on which it rains continuously and the mountains are covered with clouds to below 1,000 meters (3,280 feet), then they gather with other forest birds in the coffee plantations. Since the circulation of air is better in the light stand of trees shading the coffee bushes, it is a little drier there than in the neighboring primeval forest. On such days I have seen Emerald Toucanets perching wretchedly in the Chalun trees quite without their usual vivacity and noisiness. They find no suitable food in the coffee plantations at this season; hence I can attribute their flight only to the desire to avoid contact with the dripping leaves and branches. As soon as conditions at all permit, that is, as soon as the rain slackens and the sun occasionally shines, the Toucanets leave the plantations as quietly as they came.

Breeding

The Emerald Toucanets breed in the rain forest of the high mountains from March to June. They arrive in their breeding range in December but do not immediately start breeding activities. The flocks (of from 4 to 10 birds) begin to break up in February. The mature females leave first, and the mature males follow shortly afterwards. Birds of the previous year remain in flocks since they are not sexually mature until they are two years old, and the mature males probably return to the flocks as soon as the females have started incubation.

So far as I could observe, the roosting holes were not used as nests. The entrances of the roosting holes were always rather exposed, and the birds could be seen from some distance as they entered or left, whereas the entrances of two nesting holes which I found were so well concealed by branches and creepers that I discovered the nests only by accident.

I have only once had the good fortune to make detailed observations on an occupied nest. On April 15, 1942, I camped in a shallow valley at an altitude of about 1,900 meters (6,232 feet). The spot was a clearing in the woods, which 20 years before had been used as a

camping ground by mule trains crossing the mountains but had since been abandoned. In the intervening years, dense scrub and young trees had grown up between fallen rotting tree trunks, and everything was covered with a thick growth of vines.

While pitching my tent I noticed a Toucanet moving quietly and timidly about the camping ground. I soon found the nest, about 20 meters (66 feet) from my camp, in a rotten tree trunk some four meters high. I then suspected, and later verified, that it contained recently hatched young. From my camp I could watch the nest without interruption while I worked. At intervals the Toucanet came flying from the tops of the forest trees to smaller trees in the clearing which were about 30 meters from the nest. It always waited here a few minutes to reconnoitre. If everything seemed safe (and the bird soon became accustomed to my presence), it moved in low, swift flight to a slender branch about 50 cm. (20 inches) below the nest entrance. Here it paused again for an instant and then jumped to the hole and disappeared inside the cavity. At each such visit it remained inside some 20 or 30 minutes, which was about the same length of time that it stayed away from the nest looking for food. I have several times observed in the tropics that during inclement weather the young are brooded for a certain interval after each feeding. When I recorded the temperature in the immediate neighborhood of this nest, the reason for such behavior became apparent. During the two weeks I spent at this spot, the lowest day temperatures occurred at 6 A.M., and were between 7° and 12° C.; the highest occurred at 2 P.M., and were between 15° and 19° C. The cold was made doubly uncomfortable by the moisture in the atmosphere. And yet March and April are the warmest months there; in winter the temperature sometimes falls below the freezing point.

I never observed near the nest more than the one bird, and this later proved to be a female. It is possible that her mate had been killed, but I suspect that in this species the male does not take part in the rearing of the young. In the same week I shot two adult males from wandering flocks, which, since the sex ratio in this species is apparently balanced, would also tend to indicate that the female rears the young alone.

I never saw food in the bill of the female when she was flying to the nest, and on dissection, I found no crop for the transportation of food. While the young are small the food is either carried inside the parent's mouth or it is regurgitated.

My observations were abruptly ended on April 20. At twilight I suddenly heard distress calls from the nest of the Toucanet. When I approached the tree trunk I heard sounds of a struggle. I plugged the nest entrance to prevent escape of the predator, and at once everything was quiet. I then cut a small hole in the trunk below the nest entrance, and seeing the eyes of the predator, I fired a load of birdshot. When I

opened the trunk further I found the dead Toucanet, which had been bitten through the occiput, a dead weasel (*Mustela frenata*), and two live young Toucanets. The opened trunk and the young are shown in Figure 2. A tangle of creepers, which originally covered the trunk completely, was removed before the photograph was made. Only the lower half of the nest cavity was opened, and the undisturbed entrance can be seen in the upper part of the picture.

The lower edge of the entrance was 260 cm. (8½ feet) above the ground. Fresh wood was exposed only where the Toucanet, in passing to and fro, had worn away the edges of the hole. I assume that the cavity had been excavated originally by a Green Woodpecker (*Piculus rubiginosus*)—the site in an old rotten trunk is typical of that species. A comparison with three other Green Woodpecker holes which I measured showed that this Toucanet's breeding cavity was only slightly larger. Apparently the only work which the new occupant had undertaken was a vertical extension of the entrance, which can be seen in Figure 2. The End Figure shows the measurements of the nest, which contained no nest material. The flat bottom of the cavity was perfectly clean and was lightly covered with wood dust.

Figure 2. The Emerald Toucanet's nest, with two young. Entrance is shown in upper part of picture.

Nestlings

To judge from their size, the two young were about 10 days old. They were 9.6 and 9.9 cm. long, respectively. The eyes had not yet opened, and I had the impression that they would not open for another 10 days. The dried vestiges of the yolk-sacks were still attached to the young. No feather tracts or down were visible, and merely a few bristles showed on the hand and tail region. The ear opening was barely visible and still closed. The peculiar shape of the young bird is illustrated in Figure 3*a*. It is apparent that the abdominal cavity comprises a very large part of the body. At this age the sternum is quite undeveloped. The ratio, length of sternum to length of the ventral surface of the abdomen (measured from sternum to vent), is 1.2 cm. to 4.8 cm. in the young bird. In an adult male this ratio is 9.2 cm. to 4.7 cm. The abdominal length is thus the same in young and adult birds, whereas the sternum in the adult is 7.5 times as large as that of the young.

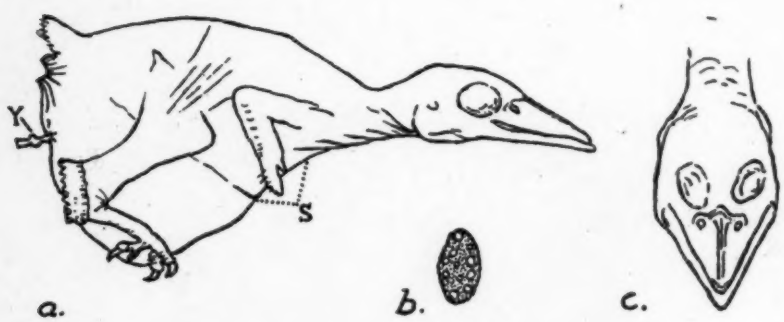

Figure 3. Emerald Toucanet. *a*. Nestling about 10 days old. *b*. Heel-pad viewed from below. *c*. Head of nestling viewed from above, showing the projecting lower mandible. *Y*. Vestige of yolk-sack. *S*. Sternum.

The wings are still very undeveloped. On the legs, the strongly developed heel-pads are conspicuous. The heel-pad is a plate attached to the ventral side of the intertarsal joint (Beebe, 1917:206; Van Tyne, 1929:30). The part of the leg above the heel-pads is strongly developed in contrast with the foot, which is still soft and flabby—an indication that the pads function earlier than the feet. The spikes or tubercles on the pads seemed to be neither definite in pattern nor constant in number. One of the young had 10 and 11; the other 12 and 14 (Figure 3*a* and 3*b*).

The bill of the young bird is rather remarkable. Its shape is very different from that of the adult bill. It is flattened (the greatest diameter at the base being lateral instead of vertical) and the lower mandible projects markedly beyond the upper (Figure 3*c*), perhaps an

adaptation for receiving food from the mother. The tongue is smooth and shaped like the bill. It is still soft, not horny and fringed as in the adult, and can be freely moved.

I do not know when the young leave the nest, but I believe it is not before the age of six weeks. Van Tyne (1929:34) estimates the nest-leaving age to be 45 days in *Ramphastos brevicarinatus*. Beebe (1917: 201) figures a nestling of *Pteroglossus aracari*, but the age of 10 days which is given for the bird is most improbable. I would estimate at least 20 days. The same bird is shown when seven days older, and one can see how slow growth is, especially in the bill. In fact, it is the small size of the bill that makes it possible, even in the field, to distinguish birds several months old from adults. (The plumage of the immature is so similar in color to that of the adult that it is difficult to distinguish the birds in the field by plumage characters.) In the male, the bill reaches its full size only in the second or third year.

Population

The population density on the breeding ground is very low, but it is even lower in the range which the Emerald Toucanet occupies between June and November, because that extends over a much greater area. One can count only three to five small flocks in one valley about 7 to 10 km. long, whose slopes have an altitudinal range of 500 to 700 meters (1,640 to 2,296 feet). In spite of this, the Emerald Toucanet cannot be easily overlooked, for its continuous calls can be heard at a distance of several hundred meters.

Calls

The calls of the Emerald Toucanet are so varied that it is impossible to describe them in detail. One thing they have in common, they are all loud and penetrating. These birds are good mimics, but they apparently imitate a given call only so long as they continue to hear the original caller from time to time. During the breeding season in the high mountains I heard most frequently the *yow yow* call of the Mexican Trogon (*Trogon mexicanus*), the *rayg rayg* of the Quetzal (*Pharomachrus mocinno*), or the *eeya eeya* of the Azure-hooded Jays (*Cyanolyca mitrata*). In the non-breeding range, I heard none of these calls, but instead the *dir-rit* of the common Jalapa Trogon (*Trogon collaris*) or the typical *hoot hoot* of the male Lesson's Motmot (*Momotus momota lessonii*). Sometimes these mimicked calls deceived me, and I would expect to see a different bird in the foliage.

Food

All the Emerald Toucanets which I examined (eight birds at different seasons) had only vegetable food in their stomachs. Their preference for ripe berries rather than large fruits is the reason that one

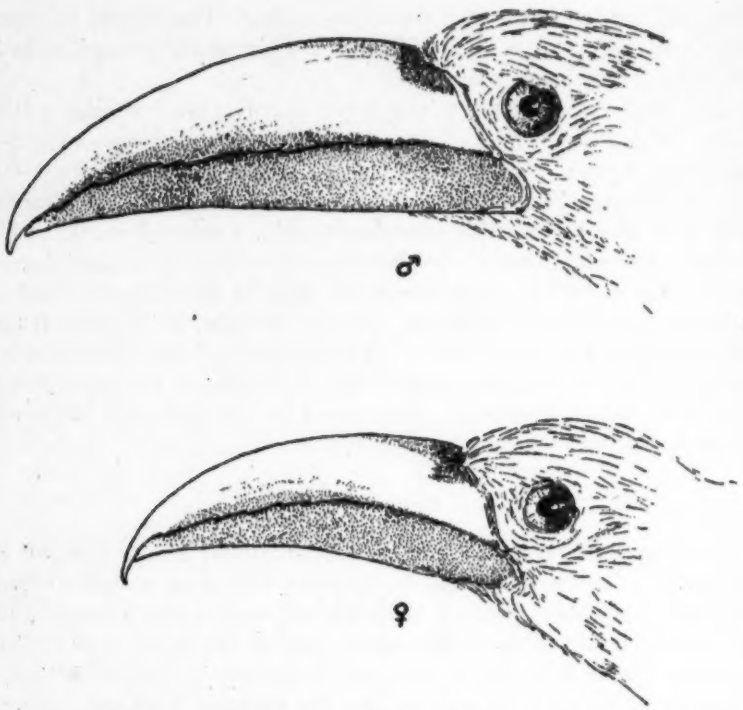

Figure 4. Heads of male and female Emerald Toucanet, showing difference in size and shape of bills. Two-thirds natural size.

finds them at given seasons, year after year, on certain trees scattered through the wide virgin forest. They feed on fruit with large pits and little pulp only with reluctance, presumably because these fruits are more difficult to eat. Several flocks may gather on a tree with an abundance of food, but they form a single unit only while they are feeding together.

During the breeding season in April (to judge from the stomach contents of the four birds which I examined) they feed mainly on a small blue berry which grows on low bushes on the highest peaks, where the prevailing winds prevent a high growth of trees. The Toucanets are joined at this season by a number of other berry-eaters from neighboring forest valleys, and it is most surprising to encounter such a flock of tropical birds where an icy wind blows shreds of cloud through the dwarf bushes.

The Function of the Bill

One cannot avoid asking the reason for the singular shape of the toucan's bill. No one who has an opportunity to observe toucans, especially the larger species, can fail to notice how cumbersome the bill is.

It has been generally held that the bill was so shaped to facilitate the picking of berries and fruit. It seems to me that exactly the opposite is true: the bill is often an impediment during feeding. This is obvious to anyone observing them when they need to bite pieces from large fruits. The broad bill of the trogon, which feeds on the same berries and fruits, is, for example, much better adapted to eating this kind of food.

In my opinion the form of the bill is a secondary sexual character, originally present in the male only, appearing subsequently in the female, though in a less striking form. The bill of the adult male is both larger than that of the female and different in shape (Figure 4). Van Tyne (1929:39) believes that "the bill of the toucan is not a special correlation of structure to function . . . but is rather to be explained perhaps as the result of an orthogenetic evolution leading to increased size of bill."

Summary

The Emerald Toucanet was studied in Chiapas, southern Mexico, at intervals from 1933 to 1943.

The habitat in Chiapas is virgin forest, at altitudes above 1,000 meters (3,280 feet), the occurrence and movements of the birds being determined by a definite degree of atmospheric humidity.

The breeding range in Chiapas is above 2,000 meters (6,560 feet) on the Pacific slope, and above 1,750 meters (5,740 feet) on the Atlantic slope. The birds spend the non-breeding season at lower altitudes.

The birds live in flocks during the greater part of the year. The adults leave the flocks in February, but yearlings (not yet sexually mature) remain in flocks.

The population density is very low.

An occupied nest was found on April 15, 1942, and observed until April 20, when a weasel killed the parent bird (a female). No male was noted near the nest during the five days of observation.

Intervals spent in brooding were about equal to intervals spent away from the nest (20 to 30 minutes).

The two young (about 10 days old) found in the nest were naked except for bristles on the hand and tail. Both eyes and ears were still closed. Wings and legs were still very undeveloped. The tubercles on the heel-pads seemed to be neither definite in pattern nor constant in number. The bill of the young was flattened, and the lower mandible projected beyond the upper. The tongue was still soft and freely moveable.

Young birds, though similar in plumage and body-size to the adults, can be distinguished in the field by the smaller size of the bill for some months after nest-leaving.

The Toucanet's calls are loud and varied and include imitations of many local species of birds.

All of the Toucanets examined (eight birds at different seasons) had only vegetable food in their stomachs.

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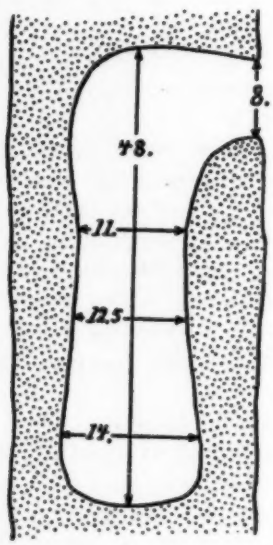

Measurements (in centimeters) of Emerald Toucanet's nest. Width of entrance: 6.1 centimeters.

A PLIOCENE FLAMINGO FROM MEXICO

BY LOYE MILLER

FIELD parties from the California Institute of Technology have been fortunate in locating a variety of fossil deposits in Mexico that included bird remains. Some have been very rich in the quantity and variety of material; for example, the San Josecito Cavern of Nuevo León (Miller, 1943), a deposit of Pleistocene age, yielded several thousand bird bones assigned to over forty species. The present paper deals with a collection of ten fragments, all but one of which are included in a single species. I am indebted to Dr. Chester Stock in charge of the explorations for the opportunity of working with the bird collections. Dr. Alexander Wetmore has loaned comparative material, and Dr. Hildegarde Howard has been a most congenial fellow student during many conferences on the flamingoes, both Recent and Fossil. To these several colleagues my sincere thanks are offered.

The ten fragments are from collecting locality No. 289, California Institute of Technology, known as the Rincón Pliocene, Chihuahua, Mexico. Associated mammal remains include horse, camel, antelope, and carnivore species. The matrix is a fine grained silt of lightest color, without cementing material. A stiff brush serves to remove it from the well petrified bones. Unfortunately the specimens are most fragmentary. They do, however, prove to be of interest in several respects; most notably they prove (since several speciments are from pre-volant young) that a small species of flamingo was present as a breeding bird. This is the earliest record for the family in America. Flamingoes are recorded from the Upper Oligocene of France (Milne-Edwards, 1868:53), but the earliest previous record from the New World is from the Pleistocene of Oregon (Shufeldt, 1892:410).

Phoenicopterus stocki, new species

Stock's Flamingo

Type specimen $\frac{289}{3245}$, California Institute of Technology, tibiotarsus (distal end) from the Rincón Pliocene of Chihuahua, Mexico. The species has the morphological characters of the genus but is of pigmy size. (See Figure 1.)

From the same locality, there were retrieved several other fragments that are here assigned to the one species. The proximal end of a tibia may have come even from the same individual, though from the opposite side. This specimen shows certain characters that are distinctive and, were the conspecific identity of the fragments more completely assured, these osteological characters could be added to the description of

the species. There is less backward extension of the inner articular facet as compared with *Phoenicopterus ruber* and *P. chilensis*, the postero-axial border of this facet (*F*, Figure 2) is more nearly an arc of a true circle, and the posterior notch (*E*, Figure 2) is shallower. In these characters the Pliocene bird approaches the Old World species, *Phoenicopterus antiquorum*, more closely than it does either *P. ruber* or *P. chilensis* from the New World. No skeletons of the genus *Phoenicoparrus* were available for comparison, but skins of the two species of

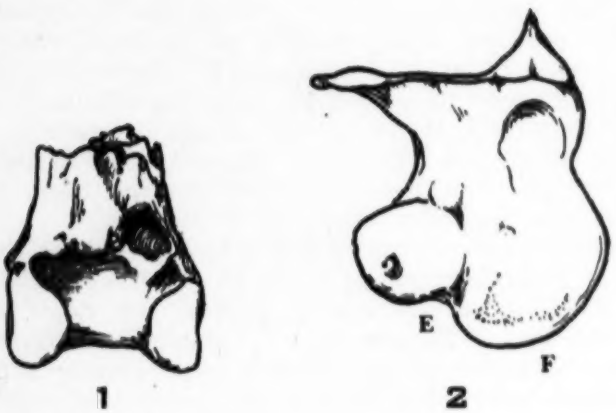

Figure 1. *Phoenicopterus stochi*. Type specimen. Tibiotarsus (distal end). Twice natural size.

Figure 2. *Phoenicopterus stochi*. Tibial head assigned to the same species as the type. Twice natural size. *E*, posterior notch; *F*, postero-axial border. Drawings by Gretchen L. Burleson.

that genus show them to be larger than the Pliocene bird. The generic characters of *Phoenicoparrus* seem to be displayed mainly in the peculiarly heavy beak with its prominent and horizontal lamellae. Whether osteological characters of the tibiotarsus are distinctive is not known. It was considered wiser, therefore, to place the fossil species in the typical genus of the family.

In making this study, certain characters of the limb bones of flamingoes (Table 1) were uncovered which might be of value to later students of the genus *Phoenicopterus*. Peters (1931:141) recognizes no geographic races in any of the species despite their wide and sometimes interrupted ranges, and homogeneity is evident in such skeletons as could be assembled. In the series of Old World birds, *Phoenicopterus antiquorum* (=*roseus*), four specimens were taken in India and one in Egypt. All are of the same sex, but there is greater size variation among those from India than appears between the Indian and the Egyptian birds. Two specimens of *P. chilensis* (♂, ♀) were examined. Both,

TABLE 1

MEASUREMENTS OF VARIOUS FLAMINGOES' LEG BONES

		Length	Width of head	Width of distal end	Sagittal diameter condyles	Width of shaft	
P. chilensis[1]	♂	298 mm.	17.7 mm.	15.4 mm.	17.5 mm.	7.1 mm.	Tibiotarsus
P. chilensis[2]	♀	273	17.2	15.7	17.6	7.2	
P. ruber[3]		307	16.6	14.0	17.6	6.9	
P. antiquorum[4]	♀	392	20.7	17.8	20.4	8.4	
P. antiquorum[5]	♀	358	21.2	17.7	20.3	7.5	
P. antiquorum[6]	♀	351	19.7	17.4	20.0	8.2	
P. antiquorum[7]	♀	358	19.5	17.2	20.2	7.8	
P. chilensis[1]	♂	290	18.5	18.5		5.4	Tarsometatarsus
P. chilensis[2]	♀	251	18.1	19.7		5.6	
P. ruber[3]		287	16.9	17.9		5.7	
P. antiquorum[4]	♀	378	20.5	20.7		6.3	
P. antiquorum[5]	♀	334	20.2	20.8		6.0	
P. antiquorum[6]	♀	352	21.0	19.6		6.7	
P. antiquorum[7]	♀	346	20.0	19.4		6.5	

1, *U. S. Nat. Mus. 344,931.* 2, *U. S. Nat. Mus. 344,932.* 3, *Los Angeles Mus. Bi-1,295.* 4, *Univ. Calif. at Los Angeles 1,786.* 5, *Univ. Calif. at Los Angeles, 1750.* 6, *Univ. Calif. at Los Angeles 1,785.* 7, *Univ. Calif. at Los Angeles 265.*

seemingly, were mature birds, but the male had longer and more slender tibia and tarsus and a smaller foot than the female. These variations are not such as commonly depend upon age, and they are probably not sexual, but individual, differences.

An interesting character is seen in the form of the intercotylar knob at the proximal end of the tarsus. In *Phoenicopterus chilensis* this knob is very broad and rounded; in *P. ruber* it is much narrower and more pointed; in *P. antiquorum* it is intermediate but approximates that of the Chilean bird. Unfortunately the intercotylar knob is not represented in the Pliocene collections.

TABLE 2

TIBIAL CONDYLES IN PHOENICOPTERUS

		Transverse diameter	Sagittal diameter	Ratio
P. ruber[3]		14.0 mm.	17.6 mm.	.78
P. ruber[8]		14.0	17.8	.78
P. chilensis[1]	♂	15.4	17.5	.83
P. chilensis[2]	♀	15.7	17.6	.83
P. antiquorum[4]	♀	17.8	20.4	.87
P. antiquorum[5]	♀	17.7	20.3	.87
P. antiquorum[6]	♀	17.4	20.0	.87
P. antiquorum[7]	♀	17.2	20.2	.87
P. copei[9]		17.0	20.0	.80
P. stocki[10]		12.9	16.2	.798

8, *Univ. Calif. at Los Angeles 1,981.* 9, *Amer. Mus. Nat. Hist. 3,485.* 10, *Calif. Inst. Tech. 3,245.* 1 to 7 as in Table 1.

In a study of the distal articulation of the tibia another interesting character is uncovered by taking the ratio of maximum transverse diameter to maximum sagittal diameter. This ratio (Table 2) is least in *Phoenicopterus ruber* (78 per cent) followed in order by *P. stocki* (79.9 per cent), *P. copei* (80.5 per cent), *P. chilensis* (83 per cent) and *P. antiquorum* (87 per cent).

Two distal fragments of the humerus were collected at the Rincón locality. Both are from the left wing, and they differ markedly in size; the larger is almost equal to *Phoenicopterus chilensis,* and the other is smaller than any living species of which the skeleton is available. The question naturally arises as to their specific identity. There appears to be a great variability in size of wing relative to leg bones in the flamingoes. In two specimens of *P. chilensis* from the same source, the male has the longer but the narrower tibia. The humerus is, however, both longer and thicker. A similar high degree of variability is seen among several specimens of *P. antiquorum* of the same sex, date, and source.

In view of this variability among Recent birds it seems justifiable to allocate all the Pliocene material to a single species although the possibility of error must be conceded. There might possibly have been two species of flamingo resorting to the same lagoon just as today we may have several species of heron feeding in the same marsh or breeding in the same heronry. Akeley (1924:128) found two species of flamingo of different genera in the same flock at Lake Hannington in northern Africa.

As stated above, the only other fossil flamingo recorded from the Western Hemisphere is *Phoenicopterus copei* of the Oregon Pleistocene, a bird which Shufeldt (1892:410) considered to be "longer winged and longer legged and toed than *P. ruber*." It inhabited a terrain that was probably not greatly different from the preferred niche of the living species of the genus, namely an open body of water with extensive mud bars from which the truncated nest-cones can be easily piled up or added to without much change of stance on the part of the builder. From this shallow mud pan the food of the flamingo is sifted by the peculiarly constructed beak held in the "topsy-turvy" position to which the birds have been structurally adapted at least since Oligocene time. It seems justifiable then to conclude that the Pliocene bird had the same habit and that the presence of pre-volant young accentuates the picture of shallow lagoon and mud flat.

Furthermore the birds seem to have a strong predilection for waters of a fair degree of salinity. The African bird is especially abundant about the bitter waters of the African plateau country. *P. ruber* is partial to those "half islands" in the Caribbean area, where water and mud are scarcely differentiated, and to the saline crater lakes of the Galápagos Islands. The Chilean bird finds in the semi-desert of Argentina, Chile, and Patagonia the same salt-pan environment (Hudson, 1920:

127). Is it not justifiable therefore to postulate a comparable environment in Pliocene time at the Rincón locality of Chihuahua?

The very word flamingo brings to the mind of an American ornithologist the thought of tropical regions, and unless he turns his attention to species other than the familiar *P. ruber* and *P. antiquorum* his judgment of the value that fossil flamingoes hold as climatic indices may be somewhat distorted. Hudson (p. 129) says that he "spent half a winter in Patagonia at a house built on the borders of a small lake, and regularly every night a small flock of Flamingoes came to feed in the water about 200 yards from the back of the house." These birds did not migrate to the milder latitudes in winter although Hudson had the impression that others of the same species that were reared at higher altitudes or farther from the coast did move to the northward in autumn. The Pleistocene flamingo from Oregon and this Pliocene species of Chihuahua do not necessarily indicate, therefore, a warmer nor yet a damper climate during those earlier epochs. They do, however, indicate a local ecologic niche that has disappeared.

A genus of birds that had reached the high degree of specialization seen in *Phoenicopterus* at a time as early as Oligocene (Milne-Edwards, 1868:53), when the horses were but the half-horses of *Mesohippus* stage, might be expected to have almost run their earthly course by Recent time. Perhaps it is not so strange that North America has more fossil flamingoes than there are represented in our living fauna.

Discussion

The New World has four living species of flamingoes belonging to two genera. Two species of the genus *Phoenicoparrus* are of restricted range and reduced numbers. The other genus, *Phoenicopterus*, has a wide range, with some striking interruptions in the specific range of *P. ruber*. The Old World likewise has two flamingo genera but with only two species. One of these (*Phoeniconaias*) again is more restricted in range, the other is wide ranging. None of the species is divisible into geographic races.

A first impression produced by this picture might be that the flamingoes had arisen as a New World group. But on the one hand, the Oligocene of Europe yielded to Milne-Edwards (1868:53) a fairly abundant fauna of phoenicopterid birds, including the typical genus as well as some less specialized in beak structure (Lambrecht, 1933:344). The number of individuals also is not insignificant. We get therefore an impression that the family was of considerable importance in the Oligocene avifauna. (Their subsequent withdrawal to the southward and the dropping out of many species follows a pattern that is not unlike those of some of the ordinal groups of mammals that are now better represented farther to the south, even in ultra-tropical latitudes.)

On the other hand we find no record for flamingoes in the New

World until much later. For fifty years the literature of American paleontology has held but one record, *Phoenicopterus copei* Shufeldt of the Oregon Pleistocene. The present paper furnishes the second record and takes the family back only to Pliocene time. The extensive Tertiary mammal beds of both North and South America are entirely lacking in flamingo remains. It seems hardly probable, then, that birds so gregarious as these could have held a place here comparable in importance with their position in the Old World. The phororhacid birds left such an extensive record in the South American Tertiaries that the flamingoes might properly have left a comparable record had they been present as a vigorous, evolving family. My own impression is that the family is a relatively late arrival in the Americas, where it has undergone minor differentiation and has survived with a greater number of living species than in its ancestral home, Eurasia.

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NESTING OF THE AMERICAN REDSTART [1]

BY BERNARD W. BAKER

FROM late June to early August, 1942, I studied five nests of the American Redstart (*Setophaga ruticilla*) at the University of Michigan Biological Station, Douglas Lake, Michigan. Since the early part of the Redstart nesting season was not covered in this study, the results reported here may differ somewhat from those obtained by other observers.[2] The nesting season in the Douglas Lake region starts in May. In 1939, at Wilderness Park, about 15 miles north of Douglas Lake, I found a nest about half finished on May 31. The season reaches its peak in June and ends in late July.

Most of the observations were made from a green canvas blind on a tower platform raised slightly above the level of the nest; some were made from the ground. Each young was marked with a daub of colored nail polish on the upper mandible, and both adults and young were banded. The net for catching the adults was made of three fine hair-nets, sewn together, and attached to a wire loop. This was placed over the nest at a 45° angle and held in place by strings. When flushed, the bird would fly directly into the net and thus was easily caught and banded.

Nesting Habitat

The preferred habitat of the American Redstart at Douglas Lake was second growth maple *(Acer saccharum)*, 15 to 30 feet high, situated on low-lying ground. This preference of the Redstart has been noted also by E. H. Short in New York (1893:197). Nests are found, however, in every kind of forest, from mixed birch, poplar, coniferous cedar forests, to ash lowlands, hemlock and tamarack. Nests 1, 2, and 5 of this study were in maple, Nest 3 in hornbeam *(Ostrya virginiana)*, and Nest 4 in black ash *(Fraxinus sambucifolia.)*

Territorial Behavior

In the last days of June and the first week of July, 1942, I found seven singing males and two nests with young (Nests 1 and 3) on an area of about one acre on Grapevine Point, about ¼ mile from the Biological Station buildings. The forest here was mostly a thick stand of young maples with a scattering of other deciduous trees.

The two nests were approximately 20 meters apart, and the seven males perched at intervals of from 10 to 20 meters in an area about 100 meters square. Hickey (1940:256) found that "the size of territories

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[1] Contribution from the University of Michigan Biological Station.

[2] I wish to express my appreciation to Dr. Olin Sewall Pettingill, Jr., and Dr. Theodora Nelson for their advice and assistance in my field work, and to Josselyn Van Tyne for aid in preparing the report.

was usually about one acre or less, but in one instance was compressed to about half an acre." He described the species as "highly territorial," and its intolerance of trespass by other Redstarts has also been noted by Short (1893:199) and Wood (1904:34). Wood, however, recorded one instance of a nest peaceably shared by two pairs.

I observed little territorial defense—possibly because my observations were made so late in the nesting season. At Nest 1, on July 4 and 6, the male drove off another male that entered the nest tree and came within two or three meters of the nest. But from two to four males sang all through the day within 100 yards of the nest tree, and occasionally two males sang at the same time within 40 feet of the nest. A strange male once (on July 14, when the young were six and seven days old) stayed near Nest 2 for 30 seconds without being chased away. The female scolded and then left the nest, returning after two minutes with two insects which she fed to the nestlings. Also a strange male perched within two meters of Nest 5 on July 15, and remained about 30 seconds; he was not driven off. The males of Nests 2 and 5 were both yearlings. The male of Nest 2 was observed at his nest only three times in 36 hours of observation, but he once displayed for two minutes near the nest (on July 12, two days before the young left the nest). Hickey (1940:255) has described the display as "short, horizontal, semi-circular flights made with stiffened wings and out-spread tails."

Song

The varied song of the Redstart has been adequately described by Frank M. Chapman (1907:293) and others. American Redstarts were singing in large numbers the last week of June and the first two weeks of July; song then gradually decreased, stopping altogether early in August. On Grapevine Point six and seven males sang during June and early July. On July 22, only three males were singing, and on July 28, only two (from the treetops instead of from the lower branches as before). July 29 and 30, I heard only one male sing each day. August 2, 3, and 4, I heard no singing at all in the area.

Singing was strongest during the morning hours. Mousley (1924: 286) states that it is unusual for the males of American warblers to sing in the nesting tree. At Nest 1, the male (a second-year or mature) often sang from the nest tree, sometimes when perched only a few feet from the nest. At Nest 2, the male (a yearling) was never observed singing in the nest tree. The males usually sang from a favorite tree near the nest, perched 4 to 15 feet from the ground, a habit also noted by Mousley (1924:285). Hickey (1940:255), however, did not observe the use of singing perches; he noted one male singing only one or two feet from the ground. Though both yearlings and second-year birds sing, the second-year Redstarts seem to have the stronger song.

I heard the yearling male at Nest 2, which was about 40 feet from my cabin, singing constantly while the nest was being built and during

the first days of the incubation period, but I never heard him sing during the latter part of incubation or at any time during the nestling period.

The female often chips softly at the nest, even when not disturbed or (apparently) calling her mate. I did not observe the females singing, though Jones (1900:36) said that the female "sings at least the more simple of the variations." Short (1893:197) said that the female utters a "sweet trill" during the mating period, but later, except for the warning call, becomes silent.

The last two days of nest life the nestlings make soft noises and flutter their wings when being fed.

Figure 1. Female Redstart on Nest 4. One nestling has worked its way through the side of the nest and strangled itself.

Nests

Nests were placed in an upright three- or four-prong crotch from 4 to 20 feet from the ground. Materials used in building the nests were birch bark, grapevine bark, milkweed fibre, feathers, grasses, and deer hair. Four were lined with deer hair, the fifth with grasses and fibres. Some nests had pieces of birch bark woven into the outside and the

bottom of the nest; the outside of one nest was mostly milkweed fibre, with no birch bark. Spider web was used in binding the outside of Nest 2 together. Chicken feathers were used in Nests 1, 4, and 5. Wood (1904:33) and Short (1893:198) found similar structure and placement to be typical of Redstart nests. Table 1 shows the measurements of five nests.

TABLE 1

MEASUREMENTS OF REDSTART NESTS

Nest	Total Width	Cup Width	Total Depth	Cup Depth	Height From Ground
1	65 mm.	48 mm.	60 mm.	25 mm.	6.00 m.
2	65	40	60	33	3.00
3	70	46	80	39	2.50
4	66	45	62	34	1.25
5	67	45	53	29	3.50
Av.	66.6	44.5	63	32	3.25

INCUBATION AND BROODING

Nest 2 (found July 2) contained a Cowbird egg (which I destroyed) and three Redstart eggs; Nest 4 (found July 13) had three Redstart eggs; Nests 1, 3, and 5 (found June 30, July 5, and July 15) contained four, two, and three young, respectively. The usual clutch is four eggs, but Wood (1904:34) found that a second set "rarely exceeds three eggs." Victor Kehrer, Jr. (MS), found the incubation period of Redstarts to be 13 days; A. L. Sears (Chapman, 1907:292) reported about 12 days for one nest.

Only the female was observed to incubate or to brood. At Nest 2, the female spent 144 of 180 minutes observation time (morning hours) on the eggs; the seven intervals on the nest varied from 6 to 44 minutes (average, 22.1 minutes); the seven intervals away from the nest varied from 2 to 10 minutes (average, 5 minutes). After the first egg hatched (between 8:00 and 10:00 A.M., July 7) the female spent 227 of 294 minutes observation time on the nest. The young was not fed the first day; the second egg hatched early on the morning of July 8; the third egg in this nest did not hatch. The female was very uneasy during the hatching of the young and would spend 30 seconds at a time inspecting the eggs and young and picking around in the bottom of the nest.

For the first few days nestlings are brooded most of the time. At Nest 1, during the first few days of brooding, the female left the nest only long enough for the male to feed the young. Brooding intervals, however, are shorter than incubation intervals, averaging 9.1 minutes; the longest brooding interval I recorded was 18 minutes. At Nest 2, the female remained on the nest on July 7, the day the first egg hatched,

77 per cent of the observation time; on July 8, 73 per cent of the observation time; on July 12, 31 per cent; and on July 14, 27 per cent. (Observation periods ranged from 204 to 394 minutes in length.) On July 15, the day before the young left the nest, she brooded only 13 of 120 minutes observation (11 per cent). The day before nest-leaving, at Nest 1 (July 5) the young were brooded only 18 minutes (during rain) of 115 minutes observation time, and at Nest 5 (July 15) not at all during 119 minutes observation.

During rain the female extends her wings over the sides of the nest, with the head held straight into the air. The female at Nest 2 always continued to brood in the empty nest during the time (about five minutes each day) that I was photographing and weighing the young.

Figure 2. Mature male Redstart feeding young at Nest 4.

The two young left Nest 2 on July 15 and 16, at the ages of eight days, and (about) eight days nine hours. Mousley (1924:285) also recorded young leaving a nest at eight days of age.

Feeding

At Nest 2, the female took complete care of the young. I saw the male near this nest only three times, and saw him attempt to feed the young only once (on the first day). At the other nests the male and female shared in feeding the young. The male of Nest 1 did most of the feeding during the first days while the female brooded; later she increased her part in the feeding. At the nest observed by Mousley (1924:287) the female fed the young 32 times, the male 12 times, in 10 hours observation; he found the average feeding interval to be 13.6

Figure 3. Mature male Redstart feeding young at Nest 1.

minutes. At the nests I observed, feeding intervals varied from 2 to 24 minutes. During the morning, nestlings were fed at average intervals of 11.1 minutes, in the afternoons, at average intervals of 13.6 minutes. The male at Nest 1 was once observed to feed the female on the nest (during heavy rain, in the afternoon of July 3, when the young were about six days old); at the same time he fed one of the young that had its head stuck out from under the female's wing. The male at Nest 2 likewise once fed the female, also during rain, during the early part of the incubation. Feedings increased in number during the last days of the nestling period. At Nest 2 the female fed the nestlings 24 times

in 290 minutes observation on July 9 (young, one and two days old), 44 times in 204 minutes observation on July 14 (young, six and seven days old).

Various kinds of insects and larvae were fed to the young—Mayfly *(Ephemera)*, Rosy Maple Moth larvae *(Dryocampa rubicunda)*, House Fly *(Musca domestica)*, and many others I could not identify. During a Mayfly hatch 90 per cent of the insects brought to the nests were Mayflies. It was not unusual for the male to bring in two or three Mayflies and feed two young on one trip. On one occasion a male brought four Mayflies at once and fed three young. Very small insects were fed the young the first day or two, larger insects later. The male at Nest 1 brought in more insects per load and fed more young than the female.

TABLE 2

WEIGHTS AND MEASUREMENTS OF REDSTART NESTLINGS

Date	Nestling	Age	Weight	Culmen	Tarsus
July 7	1	Hatched	1.10 gm.	.....	6 mm.
8	2	Hatched	1.20	2.0 mm.	5
8	1	1 day	1.80	3.0	7
9	2	1	1.80	2.0	6
9	1	2 days	2.64	3.5	9
10	2	2	3.00	2.5	8
10	1	3	3.95	3.5	10
11	2	3	4.20	3.0	11
11	1	4	5.30	3.5	13
12	2	4	5.50	3.0	12
12	1	5	6.10	4.0	15
13	2	5	6.56	4.0	14
13	1	6	6.93	4.0	16
14	2	6	7.15	4.0	16
14	1	7	7.50	4.0	17
15	2	7	7.84	4.0	16
15	1—Left nest 9:44 a.m. aged about 8 days, 1 hour.				
16	2—Left nest 2:05 p.m. aged about 8 days, 9 hours				

Nests were kept clean all through nestling life. During the first part of the nestling period the fecal sacs were eaten, but from the fourth day they were usually carried away. At Nest 2, on July 8, 9, and 10 (when the young were one to three days old), the female was observed to eat the sacs 20 times in just under 19 hours observation. On July 12 she carried away sacs six times and ate one sac in 261 minutes observation. On the following days she was observed to clean the nest eight times (in about five hours observation), and each time she carried the sacs away.

GROWTH OF NESTLINGS

The young are very helpless the first day. They are naked except for some natal down on the dorsal feather tracts and on the head. Their eyes open on the fourth day. Primary feathers begin to grow on the

third day, to unsheath on the sixth day. At seven days the young began to preen their wing-feathers, and on the eighth day spent much of the time picking and preening. The four nestlings in Nest 1 weighed 7.90; 7.95; 7.70; 8.10 grams, respectively, on the day before they left the nest, when they were about eight days old. Table 2 shows the daily weight and growth of the nestlings in Nest 2. They were weighed and measured about 6:00 P.M. (E.S.T.) each day.

Nesting Success

Five of the six eggs found (Nests 2 and 4) hatched. The two young in Nest 2 reached at least nest-leaving age. One of the three young in Nest 4 worked its way through the side of the nest and was strangled. This was a poorly constructed nest and in bad condition due to rain. I did not visit this nest after July 19, so I do not know whether the other two young reached maturity. All 10 young found in Nests 1, 3, and 5 reached at least nest-leaving age.

Summary

Five nests of the Redstart (*Setophaga ruticilla*) were studied at Douglas Lake, Michigan, in late June, July, and August, 1942.

The preferred habitat was second-growth maple, but nests were found in every kind of forest.

Little territorial defense was observed.

The males were in full song until mid-July, when song gradually decreased, stopping in early August.

Only the female was observed to incubate or brood. Except at one nest, male and female shared in feeding the young.

Incubation intervals averaged 22.1 minutes, brooding intervals, 9.1 minutes; intervals between feedings, 12.3 minutes.

Fecal sacs were eaten during the early part of the nestling period; later they were carried away.

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Marne, Michigan

BIRD STUDY AND SEMI-CAPTIVE BIRDS: THE ROSE-BREASTED GROSBEAK

BY H. R. IVOR

SOME fifteen years' study of a number of species of song birds in a semi-captive state and comparison of their behavior with that of the same species in the wild, have shown me that observation of semi-captive birds is an important and dependable method of investigating specific patterns of innate behavior. This statement is illustrated by a detailed study, made in 1939, of two pairs of Rose-breasted Grosbeaks (*Hedymeles ludovicianus*) kept in semi-captivity near Erindale, Ontario. The results are here presented,[1] not as an exhaustive account of the species, but as a short general history of one breeding season of semi-captive Grosbeaks, to be used for comparison by those who have studied this and related species in the wild. "By semi-captivity I mean that any pair of birds which nest in the aviary are given day-time liberty during the period of egg laying and incubation and full-time liberty . . . during the time of rearing the young. . . ." (Ivor, 1941:415). For other results from semi-captive birds, see Ivor (1943 and 1944).

Early Song

The Rose-breasted Grosbeak begins singing about the middle of March, but like many native passerines, it does not come into full song until later. The early song is so faint that one has to listen carefully, even at a distance of three feet, to hear it. It is typically Rose-breasted Grosbeak, but, unlike the songs of a later date, it is continuous for as much as two or three minutes. Many of the low, sweet notes of the courtship song run through it. It is, in fact, much more like the courtship than the territorial singing. For about two weeks this faint song continues; then gradually, day by day, it becomes stronger until near the middle of April it can be heard quite distinctly at a distance of some 30 feet, though it is still uttered with the bill closed. It continues to develop, and about the first of May the bird is in full song.

Territorial Behavior

During the latter part of April (1939) there was some fighting in the winter aviary among the female Rose-breasted Grosbeaks, and the males became decidedly pugnacious toward one another. This fighting was due to competition, both for mates and (presumably) for territory, although gaining evidence for the latter is necessarily difficult in an aviary. The males drove the females with some ferocity during this period, but courtship chasing did not become unmistakably evident until later.

[1] The writer makes grateful acknowledgement to Margaret M. Nice who for a number of years has given me her support and encouragement in my studies of controlled birds, and who, with Josselyn Van Tyne, was of inestimable help in preparing the present paper. Thanks are also due to Hugh M. Halliday for the photographs which accompany the text.

I was unable, in the main, to distinguish between the territorial songs of a hand-reared male and a trapped wild male, except that at times the latter added two or three long-drawn high-pitched notes at the end of his song. The song of the hand-reared bird was, to my ears, typical of those I had heard in the wild state. (Territorial behavior during nesting is described below, under "Extent of Territory.")

Mating

Toward the end of April, I moved the birds I was keeping under observation (about 25 species, comprising some 75 individuals) to the summer aviary. This was a wire-mesh structure, 26 by 30 feet in area and 7 feet high. The main flight compartment, which was 10 feet wide, was in the center of the aviary with breeding compartments on either side. During the period of mating, this flight extended the full length of the aviary, north to south, but later its northern end was partitioned off for nesting compartments. (In the restricted space of an aviary where a large number of species desire territory and nesting sites, it is necessary, of course, to allocate these.) Hawthorn and arbor vitaes were growing in the main flight, seven-foot arbor vitaes in each of the nesting compartments.

As soon as it was possible to identify mated pairs, I placed pair No. 1 of the Rose-breasted Grosbeaks in a compartment, 6 by 16 feet, on the east side of the main flight; pair No. 2 in a compartment, 8 by 10 feet, on the west side. The birds of pair No. 1 were hand-reared, the male was four years old, the female three; this was their third mating together. The male of pair No. 2 was a trapped wild bird, not less than three years of age; his mate was a three-year-old, hand-reared. (The female of pair No. 2 was from the same brood as the male of pair No. 1; the others were not related.)

Courtship Song and Display

The courtship song and display of the Rose-breasted Grosbeak are of indescribable beauty, but they have apparently not hitherto been recorded. When pair No. 1 had been placed in the nesting compartment I saw the male fly to within two feet of the female, who was on the ground close beside me. He spread and drooped his rapidly quivering wings so low that the tips of the primaries grazed the earthen floor. His body was held in a crouching position with the breast almost touching the ground; his tail partly spread and slightly elevated; his head retracted so far that his nape lay against the feathers of his back. The mating song poured forth from his open beak as he moved toward the female, weaving his head and body in an erratic dance in which he resembled some magnificent butterfly rather than a bird. The downward and forward sweep of his wings revealed in striking contrast the blacks and whites of the separated flight feathers, the vivid rose of the underwing coverts, and the white of the rump. The song, quite different from the territorial song, was soft, low, and continuous, with a

great variety of notes; some of the sweetest notes were so faint that I had to listen intently to hear them even though the bird was only two feet away. The songs of the Hylocichla thrushes are of extreme beauty, but for pure rapture I cannot recall any song which equals the courtship song of the Rose-breasted (and the Black-headed) Grosbeaks.

As the song ended, he rushed at his mate, seized her primaries in his bill, and held on so long and so tightly that I was afraid he would break them. He repeated this action three times with no resistance on the part of the female until he let go; then she tried to bite him. Suddenly the female crouched, pointed her bill toward the sky, and spread her tail. Coition followed. Immediately afterward the female shook herself vigorously, and the pair touched beaks. At once the male began again to display, whereupon the female flew at him and closed her bill on his tail. He jerked away, flew to a branch, and began his territorial song.

I observed this courtship ceremony many times during the next seven days. There were times when the female after copulation would repeatedly mount the male, taking hold of his bill before she did so. Usually the behavior of the male was one of ecstacy, while that of the female was more subdued, but sometimes her excitement also was great. After the excitement had passed, however, it was usual for her to become quite ferocious toward him—even pulling whole tufts of feathers from his body. The courtship of pair No. 2 was similar.

Since I have never heard the mating song of this species in the wild, I am unable to compare it with that of male No. 1. However, the mating song of male No. 2, the wild bird, seemed to be like that of male No. 1. There was probably some variation, for it is unusual for any two birds to sing exactly alike, but because of the great variety of notes in the Grosbeak song it would take a trained ear to distinguish differences.[2]

Nest Construction

Since the majority of the Rose-breasted Grosbeak nests I had found in the wild were built in arbor vitaes, I placed clumps of branches of this tree in each nesting compartment. These and the 7-foot arbor vitaes growing in the compartments were examined by both male and female Grosbeaks, but more particularly by the females. In 1937 and 1938 I had had several times to change the locations of the various clumps in the compartment of pair No. 1 before the female would settle on a nest site, but this season (1939) she quickly chose the site

[2] During the lives of the progeny of pairs No. 1 and No. 2, a male Black-headed Grosbeak has been in the aviary. In 1940 and 1941 the young Rose-breasted males sang the typical song of the species. In 1942, all but one began to acquire some of the Black-headed notes, and by 1943 had lost their own song so completely that at times it was difficult to tell whether it was one of them or the Black-headed Grosbeak singing. The one male retained the song of his kind, with the addition of some Black-headed Grosbeak notes.

of her 1938 nest. Female No. 2, after examining both the growing arbor vitaes and the various clumps of branches, chose one of the former.

It had been my experience that the wild bird used dead hemlock twigs of varying degrees of fineness for building and lining the nest. I carefully collected similar twigs of this tree in sufficient quantity to allow for a large choice. Although I have observed these birds in the wild break the twigs from the tree instead of gathering them from the ground, I scattered over the ground in the nesting compartment most of the twigs I had gathered; the others I placed on the arbor vitae.

The female immediately began to examine these twigs with great care. Some were merely glanced at; others were tested in the beak. Many were discarded. When a suitable twig was selected, it was taken to the nest site and carefully placed in position. Twigs were chosen much more often from the ground than from the arbor vitae.

To show that these females had, in captivity, lost nothing of the nest-building ability of the species or the knowledge of the exact quality in a twig which is important, I may say that I had to gather fresh bunches of twigs several times. Unsuitability of the remaining twigs was evidenced by the bird continually picking them up and discarding them and even flying to the wire of the enclosure when I approached. As soon as I entered the compartment with a fresh lot, she would fly to my hand immediately and begin taking twigs from it before I scattered them.

Female No. 2 finished her nest on May 22 (I do not know the exact date she began). Female No. 1 began building on May 22, laid the first egg in the unfinished nest on May 23, and finished the nest on May 24. During previous years, male No. 1 had helped in nest building, but this year neither male did so. This year, male No. 1 entered the nest, at times when the female was away collecting twigs, and seemed to examine it.

I inspected the nests continually not only while they were being built, but also after they were finished, and could detect no difference between them and those of wild Rose-breasted Grosbeaks.

Incubating and Brooding

The eggs were incubated by both male and female. They were rarely left uncovered for more than the time required for one bird to leave the nest and the other to enter it. At times the sitting bird left the nest as the returning one entered the gate. At other times the sitting bird was reluctant to change places with the one returning. If the mate remained away for an unusual period, the sitting bird would sometimes show restlessness. It then might get off the nest to drink, but left the eggs uncovered only for the length of time necessary to go to the drinking dish and back. The eggs were turned often, and since the birds sometimes returned to incubating with the feathers somewhat

damp from bathing, the eggs were kept moist. The female invariably incubated the eggs during the night. During brooding of young, both parents carried on their activities for the first few days in much the same manner as when incubating.

Figure 1. Female Rose-breasted Grosbeak being fed on the nest. About June 2, 1942.

Both parent birds gave a signal song when returning to the nest to exchange places (cf. Allen, 1916:54). These songs were shorter and much fainter than the territorial song. The birds also sang on the nest while incubating or brooding. The nest song of the tame and the trapped males seemed to be alike, but one must be very close to hear the female's nest song. (The female also sang while hunting food in the trees—a song similar to her nest song but louder. In general, she did not sing nearly so often as the male.)

Eggs and Nestlings

In their first nests three eggs were laid by female No. 1, four by No. 2. The eggs varied slightly in size, very little in color. Burns (1915: 285) gives 14 days for the incubation period, but I found 12 and 13 days (see Table 1). All seven young were reared to maturity. A slight variation was noted in the length of down between the nestlings of the

TABLE 1

INCUBATION OF SEMI-CAPTIVE ROSE-BREASTED GROSBEAKS
ERINDALE, ONTARIO, 1936–1939; 1942

	Nesting		Egg laid	Egg hatched[a]	Period[b]
Pair No. 1	1936	1st egg	May 26	June 7	
		2nd	27	8	12 days
	1937	1st egg	June 12	June 25	
		2nd	13	26	13 days
	1938 *A*	1st egg	May 27	June 8	12 days
	1938 *B*	1st egg	June 22	*broken*	
		2nd	23	July 5	
		3rd	23	5	12 days
	1939	1st egg	May 24	June 7	
		2nd	25	7	
		3rd	26	8	13 days
Pair No. 2	1939	1st egg	May 23	June 6	
		2nd	24	6	
		3rd	25	6	
		4th	26	7	13 days
Son of pair No. 2	1942	1st egg	May 26	*broken*	
		2nd	27	*broken*	
		3rd	28	June 10	13 days

[a] Since the eggs were not marked, it is not positively known that eggs hatched in the order of their laying, as tabulated here.
[b] Calculated from the laying of the last egg to the hatching of the last.

two pairs, but otherwise they seemed alike. So far as I have been able to ascertain, the exact age at which the egg tooth disappears in the nestling of the wild bird is not known; with the young in the aviary it had entirely disappeared 13 days after they hatched.

When the young of both pairs were within a short time of being ready to leave the nest, both females began to build again, outside of the aviary, leaving the care of the young almost entirely to the males. When I found and examined these second nests (nests of pair No. 2 on July 3 and July 10; [a] nest of pair No. 1 on August 1), they seemed to me typical of the species. In each, three eggs were laid, and three nestlings reared to maturity. I moved the nestlings to the aviary before they could fly. Thirteen young (nine males and four females) were reared this season, and all were perfectly normal. Thus two pairs of semi-captive birds hatched 100 per cent of their eggs and reared 100 per cent of their young. Five years later (1944) I still have in the aviary four males and one female from these broods and two of their offspring (females).

[a] The July 3 nest of female No. 2 was abandoned. The bird was on the nest when I discovered it, but there were no eggs. The nest may have been robbed.

Food Habits

When the first egg was laid in the nest of each pair, I made a small gate, two by three inches, in the wire mesh enclosing each compartment, and placed a shingle platform in the opening. In a very short time all four Grosbeaks found these gates and started visiting the woods surrounding the aviary to seek natural food. Even then the eggs were

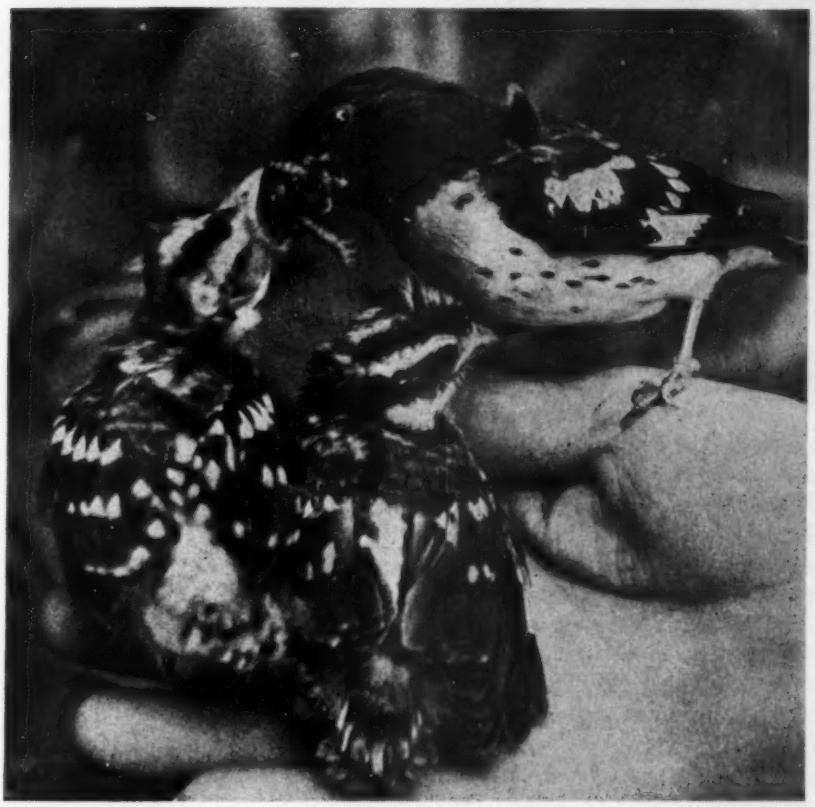

Figure 2. Rose-breasted Grosbeak male No. 1 feeding young twelve days old. June 18, 1939.

never left uncovered for more than a few moments, only one bird of a pair leaving the aviary at a time. During incubation, the usual food (a great variety of seeds and grains, fruits, vegetables, mealworms, and crushed shells) was placed before the birds, but they ate very much less of it than before they had had their freedom. They now took only their favorite foods, such as mealworms, raw peanuts, and sunflower seeds, for insect life was plentiful in the surrounding woods, and the Grosbeaks had lost none of their natural ability to recognize and secure them as food.

Just before nest-leaving, the parents fed the young a small amount of "nestling food," a quite wet paste made up of various ingredients, which I supplied. But except for this, they did not use artificial food in feeding the nestlings. To the newly-hatched young they gave very small amounts of soft-bodied insects that had been broken up and rolled around in the mouth until heavily coated with saliva.[4] They inserted the food into the throats of the young with extraordinary gentleness and extreme care. I was able to watch all of the activities of the three hand-reared adults as closely as I desired; but male No. 2, the trapped bird, was very wild and flew at me, screaming, if I approached the nest while he was there. I could handle the eggs and young of pair No. 1 (both hand-reared birds) without arousing any resentment on their part; but female No. 2 (also hand-reared) showed that she preferred that I not handle the young by gently taking hold of my finger with her bill. She showed real mistrust, however, only when I attempted to feed the nestlings. Either she would snatch the food off the food-stick as I was putting it into the mouth of a nestling, or, if I succeeded in inserting the food, she would take it out of the nestling's mouth and place it there herself much more carefully than I was able to do.

As the young grew, the parents fed them a greater number of insects, and larger insects, than before, but they showed just as great care in feeding them as when the young were newly hatched. When a large caterpillar was given, it was first well beaten, then one end was held in the beak of the parent until a secure grip was taken by the nestling and the act of swallowing was evident. The caterpillar might be withdrawn several times before the parent seemed satisfied that the nestling would have no difficulty in swallowing it. So far as it was possible to see (and with the exception mentioned above), the young were fed entirely on insects, a small amount of green stuff (apparently a tree-leaf), and at times, a little earth.

Nest Sanitation

When the young were newly hatched and during the first hours of their life the feces were not contained in a sac, but were ejected very weakly, in a small, almost thread-like string, after each feeding. The parents were exceedingly careful to see that all of the excrement was passed, even to the extent of pulling it from the vent. At this stage they always ate, and even competed for, the feces.

After the sac was formed, the parents were just as careful that it be removed immediately. After feeding they watched for the movement of the nestling which indicated that evacuation was about to take place and usually took the sac in the beak before it could drop into the nest.

[4] This great care in the preparation of food may in some measure explain the statement of Esten (1935:400) that the Rose-breasted Grosbeaks he observed "always regurgitated all foods given." I am quite convinced that these Grosbeaks do not regurgitate at any time.

At first they usually ate the sacs, but as the young grew older and the sac larger it was eaten less often. When not eaten, it was carried some distance before being dropped.

Independence of Young

When the young of pair No. 1 were 27 and 28 days old, the father began to feed them less often, and with growing reluctance. The mother, who now returned only at rare intervals to the compartment, struck at them with her beak if they coaxed for food. When they were 30 days old the father also became exceedingly ill-humored. He brought insects to the compartment, but when feeding the young, he literally jabbed the food into their mouths and immediately afterwards struck them on their bills. His irascibility was so great that they became decidedly afraid of him. Neither parent was seen to feed them after that age. I had first seen the fledglings taking seed for themselves when they were 28 days old.

The young were not allowed liberty during this year. But when they were learning to fly (at about 12 days of age), several of them were coaxed out of the aviary by the parents. All but one (a female) were found within a day or two and placed back in the compartment. I was unable to find the young female, but when she was 26 days old the father showed her the way into the aviary (or she may simply have followed him in). She had been at liberty for 14 days. When the young were put back in their compartment, I placed a guard over the entrance on the inside so that the young could not find their way out. This guard was complicated, but the parents had no difficulty in solving it.

Extent of Territory

During the time the birds had their liberty, it was quite easy to plot their territory roughly. The boundary line between the two territories was the main compartment of the aviary (extending north to south between the two nesting compartments) and a partly undetermined line running north from the aviary through the woods. The territory of pair No. 1 (whose compartment was on the east) was east of this line: the territory of pair No. 2 was west and southwest. Although the gates to the nesting compartments were alike, I observed almost no territorial trespass. What little there was occurred when male No. 2 (the trapped bird) neglected his brood for a time while his mate was busy with her second nest. On several occasions during the period of neglect, male No. 1, having arrived at his own entrance with food for his own nestlings, heard the brood of pair No. 2 literally screaming for food. He flew over the top of the aviary to the gate of pair No. 2, entered, and fed the young.

Since the second nestings were outside the aviary, it was more difficult to determine the territories exactly, but the boundary line between them seemed to be a continuation of the line between the earlier

territories. This was natural, since the males were for a time taking care of the first broods. The distance between the two second nests (somewhat more than 100 feet) was considerably greater than that between the two first nests. Female No. 1 built the second nest 115 feet north of her first; female No. 2 built 60 feet west of her first. I observed no fighting or chasing during either nesting.

Roosting

In sleep the head was placed on the back, either to the right or left, in varying positions. The positions varied from one in which the beak and most of the head were buried in the scapulars and lying alongside the wing, to one in which the beak and lower part of the forehead were buried under the wing about half an inch back of the elbow. The head might be placed in any position between these two extremes. Sometimes the whole beak, sometimes only the tip of the beak, was placed under the wing. The bird raised its wing slightly when placing its head in the extreme position (beak and lower forehead under the wing), and also when withdrawing the head from this position. (Although the whole head was never placed under the wing, the expression "with its head tucked under its wing" is, in my opinion, not entirely a misconception.)

Alertness

During the breeding season, a pair of Cooper's Hawks nested within about a hundred yards of the aviary. Screech Owls, which here prey extensively on smaller birds, also nested in the vicinity. That hawks killed many wild birds was evident from the feathers of their prey found on two or three stumps in the woods not far from the aviary. It is clear, therefore, that my birds, when allowed their freedom, needed all the natural alertness of the species.

When the young from the second nest of pair No. 2 were just beginning to fly, the father (the wild male) was killed by one of the Cooper's Hawks. Part of his body and his feathers were found a short time later on one of the above-mentioned stumps. He had been in perfect health, exceedingly alert, and quite untameable. Yet he was the only one of the 4 adults and 13 young that was killed. The male of pair No. 1 lived for nearly eight years, at last being killed by a Sharp-shinned Hawk. One of the females lived for seven years, the other for five.

Homing Instinct

As noted above, when gates were made in the aviary walls, all four Grosbeaks discovered them within a short time. Since three of these birds had not had natural food for 8 or 10 months, their first visit to the woods, where they gorged insects, was somewhat protracted. None had any difficulty whatever in finding the aviary again, nor any difficulty in finding its own compartment and entrance gate. With both

pairs, it was the male that went out of the aviary first. Upon his return, the male took his place on the nest, and the female went away to the woods. After the first departures from the aviary the length of outside visits became normal. For example, on June 12, when the young were four and five days old, the male visited the nest with food at 5:56, 6:09, 6:23, 6:27, and 6:35 A.M., the female at 5:44, 6:16, 6:19, 6:30, and 6:50 A.M. These may be considered normal for the nestling period. During incubation, returns to the nest had been less frequent.

Molt

It might be contended that the artificial food supplied to these aviary birds would affect the duration of the molt. In my opinion, however, such is not necessarily the case. Not only are the birds very adaptable, but the food supplied to them approximates that which they get in the wild. During the time they are kept entirely in the aviary, weed seeds supply a large part of their requirements, and the seeds are supplemented by various other foods such as fruit, flower buds (hawthorn, apple, etc.), and greenstuff. During the nesting season, which may cover a period of three months, they live almost exclusively on the natural food which they secure in the same habitat as the wild birds do theirs.

My records over many years show a consistent period of almost four months for the prenuptial molt. Some changes in plumage can be seen early in January, and the molt is finished toward the end of April. This molt is not complete: in the adult, the primaries, secondaries, and rectrices of the previous year are retained; but in the young, some of the flight feathers are renewed during the first prenuptial molt. Some of the young then acquire entirely new tails, others only one or more pairs of new rectrices; some acquire two or four new primaries and two new secondaries on each wing. The third prenuptial molt (spring of the bird's third year) perfects the body plumage.

The postnuptial molt begins toward the end of July and is complete by about mid-September. In the young, the second postnuptial molt (July of the bird's third year) produces the full adult plumage in the male.

Migratory Tendencies

In order to reach a definite conclusion about whether or not migratory instinct is dulled or obliterated by keeping birds captive, a very difficult series of experiments would have to be carried out. As each migration season approached, my captive Grosbeaks showed a decided restlessness, flying from perch to perch in the aviary all night. They continued this for a longer period than the migration of the wild birds would cover. I observed a certain amount of night restlessness in male No. 1 until the time of his death, at the age of nearly eight years, and

in the two females for at least five years. However, as the years passed, the restlessness became less pronounced and lasted for a shorter period. A similar decline should perhaps be expected to occur in wild as well as in captive birds, and to be evident, not only in the expression of the migratory instinct, but in all forms of natural behavior. As old age approaches, both physiological and psychological processes are slowed down.

Birds of the second generation also showed restlessness in the aviary during migration seasons, but there seemed to be some diminution. So far, I have been unable to determine whether or not this applies to the third generation of my Grosbeaks, but restlessness in them seems to be confined to wakefulness on moonlight nights.

Comment

The above observations agree with my experience with some sixty species of native song birds which I have studied under controlled conditions. And they support the conclusion that the patterns of innate behavior of a bird kept in semi-captivity may remain fundamentally unchanged. I should like to emphasize, however, that the conclusion does not necessarily apply to all species of birds, and that it is only birds kept in a proper environment that will yield valuable results in behavior study. Birds kept caged under completely unnatural conditions will, of course, behave unnaturally (see Scott, 1904).

The comparatively close quarters of even the largest aviary may magnify antipathies, which can result in much more severe fighting than would be usual among wild birds. This, however, is only an exaggerated form of natural behavior, not a fundamental change. Preliminary selection of territory and its defense also modified in an aviary. But it is clear from the above Rose-breasted Grosbeak history that, with these possible exceptions, the innate behavior of my semi-captive birds did not differ from that of wild birds to a greater extent than could be caused by individual variation. That a controlled bird will differ from a completely free bird is self-evident, but it differs simply by the addition of learning to innate behavior. Since this paper deals only with innate behavior patterns, no description has been given here of the innumerable instances of learning, nor of the insight into bird psychology gained through the study of controlled birds. Such study does not take the place of observation of wild birds, but is supplementary to it, and yields exact and detailed knowledge that is otherwise difficult or even impossible to obtain.

Summary

To illustrate the value of semi-captive birds in the study of bird behavior, an account is given of detailed observations, made in 1939, on two pairs of Rose-breasted Grosbeaks (*Hedymeles ludovicianus*) which were kept in semi-captivity near Erindale, Ontario.

Song is not fully developed until about the first of May, but a faint

early song, different from the later territorial and courtship songs, begins near the middle of March. Territorial behavior is evident during the latter part of April. Courtship song and display (here first described in detail) begin in late April or in early May.

One female laid four eggs, the other three eggs, in the first nests of the season (built in the aviary in the latter half of May); three eggs were laid in each of the second nests (built outside the aviary).

All 13 eggs hatched and all 13 young were raised to maturity.

The parents shared in incubating, in brooding, and in the care of the young. When the females started the second nests, the males took almost complete charge of the first brood.

The incubation period was 12 to 13 days; nestling period, 10 days; period of dependence of young after nest leaving about 20 days.

The parents used a signal song when exchanging places on the nest, and also sang on the nest while incubating and brooding.

When allowed freedom after the first eggs were laid, the birds regularly visited the woods to feed on insects, ceasing almost entirely to use the artificial food provided in the aviary.

The young were fed insects, greenstuff, and a little earth (a small quantity of artificial nestling food was given them just before nest leaving).

The excrement was eaten by both parents during the first days of the nestling period; later, it was sometimes eaten, sometimes carried away.

Both pairs observed territorial boundaries.

One male several times fed the nestlings of the other male, when these were neglected by their parents.

The Grosbeaks lost none of their natural alertness in semi-captivity.

They found the entrances to the aviary without difficulty after foraging in the woods.

The prenuptial molt (not complete) extends from January to April, postnuptial molt (complete) from July to mid-September. In the first prenuptial molt some flight feathers are renewed, but the adult retains the flight feathers from the previous year. The third prenuptial molt perfects the body plumage, the second postnuptial molt produces the full adult plumage in the male.

At the time of spring and fall migration, the captive birds showed night restlessness, which decreased as the birds grew older.

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COOKSVILLE, ONTARIO

THE CHESTNUT-COLLARED LONGSPUR IN MANITOBA

BY R. D. HARRIS

THE nesting habits of the Chestnut-collared Longspur (*Calcarius ornatus*) were studied during the years of 1930 to 1932 inclusive, on a half square mile of prairie pasture on the western outskirts of Winnipeg, Manitoba.[1] A total of 23 nests were observed.

Migration

Spring. The first arrivals were noted on April 10 (1932), April 11 (1930), and April 12 (1931). The main migration began a day or two later, and lasted until about April 18. After that date, occasional birds were seen flying overhead, but such flights seemed to be only local wanderings. On the first day of migration, no more than a single individual was usually noted, but afterwards 10 or 12 were counted in a day. They arrived principally during the forenoon, either singly or in groups of two or three.

Autumn. The birds collected into flocks before turning southward. Young birds were the first to gather, frequenting the outskirts of the nesting areas. With the termination of nesting about the middle of August, adults joined the flocks of juveniles. The species then entirely abandoned the grassy breeding grounds, and was found in adjacent ditches, dried-up sloughs, and similar low-lying, rough ground (though rarely stubble or plowed land). This rather remarkable change of habitat may be due to the availability of the autumn crop of weed seeds, combined with the reduced number of grasshoppers, which constitute the bulk of the species' food in summer; but the cause may lie deeper than that, and involve the psychological and physiological changes bound up with migration. Young and old together spent the last half of August in the new habitat, in loose, restless flocks numbering up to 30 or more individuals. During September, southward migration began, and the latest date on which I noted the species at Winnipeg was September 28.

Pre-nesting Period

Habitat. On arrival in April the birds settled immediately on their breeding ground. In the present study, this consisted of prairie, its flatness relieved by occasional low ridges and shallow sloughs. The dominant vegetation was composed of grasses of the following species: *Panicum virgatum, Poa arida, Agrostis hyemalis* and *Agropyron tenerum.* Wolfberry (*Symphoricarpos occidentalis*) in straggling

[1] The writer is indebted to B. W. Cartwright, A. H. Shortt, and T. M. Shortt for their generous assistance in the course of the investigation, and to Margaret Morse Nice for reading a preliminary draft of this paper. [Mr. Harris, overseas with the R.C.A.F., was unable to check the final proofs of this paper, but Margaret M. Nice and T. M. Shortt have given invaluable help in preparing the manuscript for publication.—Ed.]

patches, prairie sage (*Artemisia gnaphalodes*), goldenrod (*Solidago canadensis* and *S. hispida*), and gum-weed (*Grindelia squarrosa*) were also present.

Courtship and mating. During a visit to the nesting area on April 14, I found the birds widely scattered and wandering restlessly. I heard no singing. Although the snow had disappeared and higher spots were dry, low-lying areas were covered with water. Only a few insects had appeared. Five days later the land had dried considerably. Both males and females were present in abundance, and a few males were in song. At least two males, one of which was accompanied by a female, appeared to have staked claims to territories. On April 27, singing was vigorous, and swift erratic pursuits of females by males were frequent. On May 9, I observed competition between males for the same female, once seeing as many as four males together, fighting, singing, and springing aloft in outbursts of zeal. By May 22 all the birds were paired.

Territory. A nesting territory of this species is usually roughly circular in shape, and comprises an area of short, open grass, with a variable quantity of wolfberry used by the male for perches. Two territories that were measured contained 25,000 and 45,000 square feet respectively. The territory has no definitely marked boundary, but merges into an area of unclaimed ground which the nesting pair may occasionally visit. Tussles between neighboring males sometimes take place in this area, both on the ground and in the air, and always seem to end with the retreat of the one that has ventured the farther from his own territory.

Nesting

Nest construction. The nest is located in the central part of the territory. A second nest built by one pair was placed 40 feet away from their first nest; another pair built their second nest 100 feet from their first. These moves involved no alteration in the boundaries of the territories. The nest is built on the ground, in light to moderately thick grass, sometimes in a scattered growth of short wolfberry. Of the 23 nests found, 10 were beside cattle droppings. DuBois (1935:70-71) records several nests well concealed. In the present study the nests were usually situated in rather sparse cover a few inches high. Only one nest was located in heavy grass. Grass was always the main cover plant; in four instances, wolfberry contributed to the concealment; gum-weed was present around one nest, and other herbaceous plants around another. The poorer concealment noted in this study, as compared with the findings of DuBois, may have been partly attributable to grazing and to the abundance of grasshoppers. The nests measured in internal diameter, 2.2 to 2.6 inches; in internal depth, 1.5 to 1.9 inches. The lower portion of the nest fits into a hollow in the ground, excavated, according to Bailey and Niedrach (1938:244),

by the female. Above ground, there is a large, solid rim of dry grass. The wall is thin but firmly woven, of dry grass, with, occasionally, leaves and herbaceous stems; it is usually lined with finer grass, and in two nests a little horse or cow hair was added to the lining. In the nests described by DuBois (1935:71), only grass was used in the main body of the nest, with hair often added in the lining.

Nesting season. During the three seasons of this study, I found a total of 23 nests (Table 1), the earliest on May 27 (two nests: No. 11, which contained one egg; and No. 12, which was under construction), the latest on August 1 (nest No. 23, which contained one egg and four young). Sixteen of the nests contained eggs when found, three contained young, three contained both eggs and young, and one (mentioned

TABLE 1

NESTING DATA FOR THE CHESTNUT-COLLARED LONGSPUR AT WINNIPEG, MANITOBA, 1930–1932

Nests	Date found	Contents when found	Total eggs laid	Date of hatching	Size of brood	Date of nest-leaving
No. 7	June 29	5 e	6	July 10	6	July 19
8	July 17	5 e	5	July 19	4	
9	July 31	5 e	5	Aug. 5	5	Aug. 14
10	July 31	4 e	4	Aug. 1–4	3	Aug. 11–13
11	May 27	1 e				
12	May 27	0				
13	June 13	1 e, 4 y			4	
14	June 13	1 e, 5 y			5	
15	June 13	5 e	6	June 23–24	6	July 3–4
16	June 16	5 y			5	
17	July 8	1 e	4	July 21	3	July 31–Aug. 1
18	July 17	5 e	5	July 27–29	5	Aug. 4–6 ?
19	July 18	5 e	5	July 23– ?	?	
20	July 20	4 e	4	July 23–?	3	Aug. 2–3
21	July 20	4 e	4	July 23–24	4	
22	July 26	5 y			5	July 26
23	Aug. 1	1 e, 4 y			4	Aug. 7–8 ?

e = eggs; *y* = young.
See text for data on Nests 1 to 6, and for further data on Nests 8, 11, 12, 17, 18, 23.

above) was under construction. I found nests with young as early as June 13 (Nests 13 and 14), but the earliest hatching I actually observed was June 23 (Nest 15). Table 1 summarizes the nesting data; Table 2 presents an analysis of egg-laying dates.

Description of eggs. Thirty-four eggs, comprising eight sets, were measured. The means were as follows: long diameter, 20.0 ± 2.0 mm.; short diameter, 14.5 ± 1.2 mm. Their shape was ovate, but in one set examined the eggs were unusually rounded, almost broadly elliptical. One abnormal egg was seen—not included in the above measurements—

the smaller end of which was elongated for about 3 mm. DuBois (1935:69) records one set (out of 21 sets found) of small, nearly spherical eggs. The ground color of the eggs ranged from a greenish white through various shades of white, gray and buff, to a deep brownish buff. The first and last shades were unusual, however, and the most common color was one varying from gray to pale buff. The markings consisted of deposits of dark reddish-brown pigment, either on or below the surface of the shell, in the latter case appearing a cloudy lavender color. The markings varied from fine specks and lines to heavy irregular blotches (a wide mixture occurring in a single egg), and were most dense at the larger end.

Date of laying. Table 2 shows the distribution (by 10-day periods) of the dates of completing egg-sets in Manitoba, together with a similar distribution given by DuBois (1935:69) for Montana. A comparison

TABLE 2

DISTRIBUTION BY TEN-DAY PERIODS OF THE DATES OF COMPLETING EGG-SETS

DuBois, Montana		Harris, Manitoba	
Period	No. completed	No. completed	Nests
May, 1st third	1 (4.5%)	0	—
2nd third	5 (22.8%)	0	—
3rd third	2 (9.1%)	3 (17.6%)	Nos. 11, 13, 14
June, 1st third	6 (27.3%)	3 (17.6%)	Nos. 8, 12, 16
2nd third	2 (9.1%)	1 (5.9%)	No. 15
3rd third	3 (13.6%)	1 (5.9%)	No. 7
July, 1st third	3 (13.6%)	1 (5.9%)	No. 22
2nd third	0	6 (35.3%)	Nos. 17–21, 23
3rd third	0	2 (11.8%)	Nos. 9, 10
	22 (100.0%)	17 (100.0%)	

Data from 17 clutches (Nests 7 to 23—see Table 1). The date of laying of the final egg was known from actual observation at three nests (Nos. 7, 15, and 17); hypothetical dates of May 30 and June 3 were used for Nests 11 and 12 (see text); for the remaining twelve nests the date of laying of the final egg was calculated on the basis of an ascertained laying rate of one egg per day.

of the two sets of figures shows that nesting is one or two weeks later in Manitoba than in Montana. The figures also point to the existence of two main egg-laying periods. In the present study, the first main period extended from late May through early June, the second from July 11 to 20. The date of laying the first egg of a clutch was known from actual observation at two nests: May 30 at Nest 12; July 8 at Nest 17. The date of laying the last egg of a clutch was known at three nests: June 30 at Nest 7, June 14 at Nest 15, July 11 at Nest 17. Thus both dates were known from actual observation only at Nest 17:

July 8 to July 11 (a clutch of four). The dates for other nests were calculated, however, on the basis of an ascertained laying rate of one egg per day.

Number of sets. Two of the pairs under observation each completed at least two nestings in a season. Apparently no change of mates took place, but this point was not definitely ascertained. In the case of one pair (Pair C), laying of the first clutch began on June 9 (nest No. 15, Table 1); the six young left the nest on July 3 and 4; on July 8 laying of the second clutch (nest No. 17) began; only four eggs were laid; the young left on July 31 and August 1. Pair B had been observed feeding a brood of young in their territory when their first observed nest (No. 7) was found on June 29. The nest contained five eggs, a sixth egg was laid on June 30, and six young left the nest on July 19. The young they had been feeding remained in the territory until July 6. Another nest (No. 9) of this pair was found July 31, when it contained five eggs; five young left on August 14. DuBois (1935:69) concludes from his tabulation of data (summarized with mine in Table 2 of this paper) that "the distribution of dates . . . leaves it uncertain whether more than one brood is raised each year," and that the protracted nesting season may be due to repeated unsuccessful trials. But it would seem from the above evidence that three broods are at least occasionally raised in a season, while two per year is a common condition, and perhaps the normal one.

Size of clutch. The following data are taken from the clutches known to be complete (nests Nos. 7-10, 15, 17-21,-Table 1): number of clutches, 10; number of eggs, 48; average number of eggs per clutch, 4.8. The frequency distribution is as follows: 4 clutches of four; 4 clutches of five; 2 clutches of six. In Montana, DuBois found (in 20 sets known to be complete): 14 sets of four eggs; 6 sets of five; none of six. Pairs A, B, and C, all known to have nested twice or three times, each had a clutch of six in their first observed nest of the season; Pairs A and C had clutches of four, Pair B, a clutch of five in the second observed nest of the season.

Incubation. Eggs are laid on successive days. Although laying appears to take place only in the early part of the morning, the female is usually to be found on the nest at any time of day. The incubation period (from the laying of the last egg to the hatching of the last), determined at three nests (Nos. 7, 15, and 17), was 10 days, though DuBois (1935:70) records 12½ days for one nest (in Montana). Incubation is by the female only. She is difficult to flush, and some individuals, when discovered, drag themselves away through the grass with wings half spread and fluttering. Once having left the nest, she remains hidden until the observer has gone.

Activities of male. During the incubation period, the male divides his time between feeding quietly in his territory and mounting guard on his favorite perch. Wolfberry is used by the male for perches—

though he may also select stones, fences, and telephone wires when these are present. Perches are rarely used by the female during nesting, but regularly by the male, who selects one or two definite stations near the nest. He watches attentively for his mate, and when she flies to or away from the nest, he follows and alights beside her. Now and then throughout the day he launches himself into the air, rises to a height of 10 to 50 feet, spreads wings stiffly, and, floating slowly to earth, delivers his short, clear melody. At the approach of a human intruder, the male retires to his favorite perch, from which he marks the intruder's progress. With uneasiness growing stronger, he takes wing and flies back and forth over his territory, giving utterance to a warning *wheer* note and sometimes a song. Some males have a habit on these occasions of reaching the highest point of their flight directly over the nest.

Hatching. In one observed case, hatching of one egg required over half a day, but in the majority of cases it seemed to take a shorter time. An irregular series of perforations is made by the young bird around the circumference of the shell about mid-way down the main axis. When the cut is completed, and the young bird has finally extricated itself, the two halves of the shell are carried away by the parent; pieces of shell have been found as far as a hundred feet away from the nest.

Young

First day. Newly hatched birds lie prone in the nest, flexing their limbs only occasionally, and raising their heads with difficulty. They are covered with buffy gray down about one-fourth inch long. On the capital tract two rows of down, beginning at the loral region, run posteriorly to the occipital region, where they join a transversely placed tuft. An isolated tuft stands above each eyelid. A wide patch occurs in the spinal region, narrowing as it enters the pelvic region. Down is abundant in the humeral tract. In the alar tract, it is distributed in two rows on the dorsal surface. A prominent patch is found in each femoral tract, and scattered tufts can be detected in the crural tract. Mandibles are flesh color, darkening at the tip. Tarsi, toes, and claws are pale flesh color.

Second day. The young show a little more activity on the second day. They are brooded by both parents[2] alternately for periods of from one to 20 minutes, each period being terminated by the arrival of the other parent with food.

Fourth day. Feather sheaths in all tracts are above the skin. The eyelids are now separated but cannot be moved.

Sixth day. The birds struggle when handled; eyelids are movable; feathers are beginning to break sheaths on all parts except the head.

[2] In my notes, the male is recorded as taking part in brooding, but Margaret Morse Nice (1943, *in litt.*) thinks that if a bird does not incubate it probably doesn't brood, and suggests that the male Longspurs may have merely stood over the young as she has observed male Song Sparrows do. I have not had the opportunity to clarify the point.

As an indicator of the rate of feather growth, the length of a single primary was measured daily in the case of several birds. Plotted graphically, these measurements showed an almost constant rate of growth, and graphs of the measurements of young from two different nests were almost exactly equivalent. Starting at zero on the second day, growth proceeded at the rate of 2 mm. per day up to the fourth day; it then maintained a steady rate of 3 mm. per day for the remainder of the nestling period.

TABLE 3

CARE OF YOUNG (AT NEST 18)

	Age 1–3 days	Age 5–7 days
Period observed	July 30, 11:00–12:04 A.M.	Aug. 3, 11:15–12:18 A.M.
No. nestlings	5	5
Feedings by ♂	8	2
Feedings by ♀	9	24
♂ brooded[a]	Twice (total of 4 min.)	0
♀ brooded	8 times (total of 44 min.)	0
♂ cleaned nest	Once[b]	0
♀ cleaned nest	Twice[c]	7 times[d]

[a] See Note 2 of text.
[b] ♂ swallowed one sac, flew away with one.
[c] ♀ swallowed three sacs.
[d] ♀ carried away sacs.

Parental attention. Male and female share the burden of caring for the young in the nest, but the male's part is a subordinate one. Brooding periods become progressively shorter, and daytime brooding ends altogether on the fifth day after hatching. Thenceforward the daylight hours are spent, by the female particularly, in an almost ceaseless hunt for and transport of food. Both parents clean the nest, either swallowing the sacs or flying off and dropping them some distance way. Two observations on feeding visits are summarized in Table 3. As the nestling period progressed, rate of feeding and of nest cleaning increased, though the male grew less attentive. So far as could be determined by observations from blinds placed two to three feet from the nests, the almost exclusive food of nestlings is grasshoppers, which, during the years when the present study was made, were extremely abundant. Species collected are as follows: *Chorthippus curtipennis, Camnula pellucida, Arphia pseudonietana, Melanoplus dawsoni, Melanoplus bivittatus, Gryllus assimilis* (identified by Norman Criddle).

Nest leaving. The young left the nest when 9, 10, or 11 days old; DuBois (1935:68) gives a nestling period (one nest) of "about 10½ days." The actual departure of a brood was witnessed once. The move-

ment, perhaps stimulated by my activity around the nest, began without warning. The birds suddenly became very restless, kicking violently, and soon were panting hard for breath. After a few minutes they stopped simultaneously, and were quiet for about ten minutes. Again they began, and this time one bird, curiously enough the smallest of them all, pushed itself over the rim and crawled and hopped away from the nest in a wildly erratic course, finally coming to rest beside me two feet from the nest. Meanwhile, another bird, which had projected itself over the opposite side of the nest, turned back, and, shoving itself across the backs of its fellows in the nest, went toward the first one. The birds began to utter the *chi-eep* note and were answered by their parents, which were flying about overhead. After a general period of rest, a third one managed to scramble out, and the second one, in amazingly strong hops, followed an aimless course around the nest.

Post-nestling Period

On the day of nest leaving, the bird is quite incapable of flight, and, except for occasional attempts at hopping, it remains crouched in the grass, receiving food from its parents. It grows, however, with extraordinary rapidity. After another day it is able to fly, when alarmed, for 100 feet or more. The flight is direct and labored. After alighting, the bird crouches upon the ground—I did not determine the age at which it is able to stand upright and walk.

Fourteen days after hatching (four days after leaving the nest), the young bird begins to use the *til-lip* call note characteristic of the species. Its flight has now become undulating.

On the fifteenth day the bird is still being fed regularly by the male parent and occasionally by the female. If another nest is to be started, the female stops caring for the young at a time varying from two to seven days after they have left the nest; thenceforth they are in the sole care of the male.

By the twenty-fourth day, the bird appears to be fully grown. It may still be attended by the male parent, but it has sometimes to assume a begging posture, with wings outspread and fluttering, before the parent will give it food.

It begins to wander at large on about the twenty-sixth day. If the parents are finished nesting, young and old go off together, but otherwise the young bird joins roving bands of juveniles.

Nesting Success

For the three seasons of this study, nesting success was remarkably high. In 10 nests for which there are adequate data (Nests 7, 9-12, 15, 17, 18, 20, 23—see Table 1), a total of 44 eggs were laid (this includes *five* eggs for Nest 23 where four eggs had already hatched when I discovered the nest). Of these 44 eggs, three failed to hatch (one each at Nests 10, 20, 23); six disappeared (one each at Nests 11

and 17, four at Nest 12). Of the 35 young which hatched successfully in these 10 nests, three were killed in a storm (one at Nest 18, two at Nest 23); and 32 young (72 per cent of the total number of eggs laid in the 10 nests), reached nest-leaving age. Mrs. Nice (1937:143) estimates an average of 40 to 46 per cent success for open nests in the North Temperate Zone. (For comparison: leaving out of consideration young already hatched when nests were first discovered, a total of 80 eggs was recorded in all 23 nests: 40 of these hatched, 5 failed to hatch, 7 disappeared, 4 were collected; for the remaining 24 eggs, data are either lacking, as in Nests 2, 4, and 5, for example, or inadequate, as in Nest 19, and they must be classified under "fate unknown.")

Because of incomplete data, 6 of the 23 nests found are not included in Table 1: Nest 1 (with 3 young) and Nest 2 (with 5 eggs) were found on July 15; Nest 3 (with 4 Longspur and 2 Cowbird eggs—all collected) was found on July 13; Nest 4 (with 4 eggs) on July 22; Nest 5 (with 5 eggs) on June 6; Nest 6 (with 6 eggs) on June 28. There were no later data on Nests 1-5. In Nest 6, I found one young with skull open on July 17; the other five eggs may have hatched and the young left.

Data (not included in the table) on other nests are as follows: In Nest 8 (found July 17 with 5 eggs), one egg disappeared between July 17 and 20; the parents deserted the nest and young (hatched July 19) when I erected a blind near the site. Nest 11 (found May 27 with one egg) was abandoned after the egg disappeared on May 29. Nest 12 was discovered on May 27, when it was still under construction; it was finished May 29; the first egg was laid May 30; three more eggs were laid on the three succeeding days, but all disappeared on June 6. In Nest 17 (found July 8 with one egg) four eggs were laid, but one disappeared on July 18. A sudden rainstorm, accompanied by a sharp drop in temperature, occurred on August 6 when the five young in nest No. 18 were 8 to 10 days days, and the four young in nest No. 23 were obviously ready to leave the nest (their exact age was unknown). Later I found one dead young outside nest No. 18, and two dead in nest No. 23. I found no trace of the other young, which also may have been killed by the storm.

I did not identify the agents responsible for the disappearance of the seven eggs (one each at Nests 8, 11, and 17; four at Nest 12). The ground squirrel (*Citellus tridecemlineatus*) and the garter snake (*Thamnophis sirtalis*) were likely suspects.

Voice

Song. The song is a short trill, lively and melodious, generally given as the bird glides to earth on set wings after an upward flight to a height of 25 to 50 feet. The song conforms almost invariably to one pattern, except in the ending, which varies between individuals. My own rendition of it is: *say it loud, so loud, ul - ee - ee,* and these words

indicate the tone and tempo fairly well. One male, instead of using this song pattern, sang a curious combination of alarm and flocking notes: *wheer wheer wheer, lil-lip.* Longspurs appear to explore the possibilities of their voice in the first autumn, for on August 15, a young bird perching on a fence was heard to utter hesitantly a jumble of notes reminiscent of a distant flight song of a Western Meadowlark. It experimented with variations for several minutes.

Calls. The common call note is a *til-lup* or *til-lip* (the accent on the first syllable), sometimes lengthened to *til-lil-lip.* It is a general flocking and flight note, and in the breeding season it seems to express anxiety. The usual alarm note is a whistled *wheer,* used mostly by the male. A *tzip* and a rattling *tri-ri-rip* indicate extreme alarm and perhaps anger. On coming to the nest with food, the female sometimes utters a soft *lu,* and the young then stretch open their mouths. Low, conversational notes are exchanged between the parents at the nest.

Notes on Plumages

On arrival in spring, some birds are not yet in full breeding plumage (produced by molt on head and throat, and by wearing off of the buffy tips from the black and chestnut of the body plumage—see Dwight, 1900:184). A male, for example, was seen on April 27 that had a large area of the black underparts still covered by the pale feather tips. Post-nuptial molt begins about July 20 and is still incomplete when the birds move south. Occasionally a male is encountered in summer with areas of chestnut on the black underparts. Another anomaly is the occurrence of females in male plumage. DuBois (1935:69, and 1937:107) observed at least three females of this type, one "with all the male markings"; the others in an intermediate plumage, with the black underparts, but lacking the chestnut collar. A female with this intermediate type of plumage was collected on June 14, 1933, by T. M. and A. H. Shortt on my study area (it was carefully sexed). The specimen is now in the Royal Ontario Museum of Zoology. The whole plumage was like that of a male, except that all the browns were paler.

Summary

A study was made of 23 nests of the Chestnut-collared Longspur (*Calcarius ornatus*) during the years 1930 to 1932 near Winnipeg, Manitoba.

Spring migration extended from about April 10 to April 18. Fall migration began with flocking (the young gathering first) on the outskirts of the nesting areas; the last stragglers had left by the end of September.

Courtship and territory selection began in the latter part of April and early May.

Territories were roughly circular, from 25,000 to 45,000 square feet in area.

Most of the nests were placed in low grass with little concealment.

Egg laying in Manitoba began in late May (two weeks later than DuBois found for Montana).

Clutches varied from 4 to 6 eggs, the average of 10 clutches being 4.8. (No six-egg sets were found by DuBois in Montana.)

Two nestings per season seemed to be usual, and three nestings occasional. Later sets were smaller than the first.

Incubation was by the female only, but the parents shared in caring for the young. The incubation period (determined at three nests) was 10 days; the nestling period, from 9 to 11 days. The young were independent 24 days after hatching (14 days after leaving the nest).

Nesting success for 10 nests was 72 per cent.

Except in its ending, the flight song conformed almost invariably to one pattern. In addition to the flight song, the Longspur used a variety of call notes.

The postnuptial molt (which is complete) began about July 20; the prenuptial molt is incomplete.

One female was recorded whose plumage resembled that of the male.

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Binscarth, Manitoba

GENERAL NOTES

Notes on molting time of loons and grebes.—George Miksch Sutton (*Wils. Bull.*, 55, 1943: 145–149) has indicated that Loons probably do not undergo two complete molts per year. The extent of the prenuptial molt especially seems to be uncertain, and the time of the postnuptial molt may vary greatly, some individuals probably not acquiring their winter plumage until they have reached the wintering grounds. The same latitude in time seems to be true of the prenuptial molt.

On April 13, 1940, I observed 15 Common Loons (*Gavia immer*) on Guilford Lake, Columbiana County, Ohio. I was puzzled to see that two of them were still in winter plumage while the others were in breeding plumage. On April 20, 1940, I saw 14 Loons there, two still in winter plumage. On April 27 and 28, 1940, I saw 12; two, probably the same ones observed before, were in winter plumage. On April 11, 1941, I saw six loons at Guilford Lake, one still in winter plumage.

On October 20, 1941, I saw two Holboell's Grebes (*Colymbus grisegena holboelli*) at Jefferson Lake, Jefferson County, Ohio. Both were still in breeding plumage, with the reddish neck plainly visible. It would seem, therefore, that grebes might fall into the same category as loons in regard to variation in time of molting.—Forest W. Buchanan, *Amsterdam, Ohio.*

Cooper's Hawk observed catching a bat.—On the evening of April 26, 1943, I. T. Bode and I sat on the porch of a cabin on Caney Mountain State Game Refuge, Ozark County, Missouri, watching the dusk descend. Two small brown bats (species unknown) were flitting over the creek in front of the cabin, when a Cooper's Hawk (*Accipiter cooperi*) burst through an opening in the trees and took after one of the bats. A short chase ensued, in which the bat twisted to the right and left with the hawk following every turn. As they passed 50 feet in front of us, the hawk tipped back on its fanned tail, reached an incredible distance forward with both feet, and gracefully picked the bat out of the air. With scarcely a flutter the bird recovered normal flying posture and went out of sight in the timber, carrying the prey. This incident occurred at about 8:00 P.M., E.S.T., by which hour it was becoming quite dark. The bats had been out for at least 30 minutes. We were surprised to see the Cooper's Hawk abroad so late.

Allen ("Bats," 1939: 280–292) summarizes the literature on the known raptorial enemies of bats, most of which are owls and falcons. Stager (*Condor*, 43, 1941: 137–139) reports an instance of several Duck Hawks preying regularly upon Mexican free-tailed bats around a cave in Texas. But I am unable to find any record of accipitrine hawks utilizing such prey.—A. Starker Leopold, *Missouri Conservation Commission, Jefferson City, Missouri.*

Evidence of polygamy among Marsh Hawks.—Marsh Hawks (*Circus hudsonius*) are common winter and summer dwellers in the Palouse country of southeastern Washington. As a matter of fact, they are one of the most numerous of the hawks in this region. While studying the nesting habits of the Hungarian Partridge during the spring of 1940, I kept under observation two Marsh Hawk nests in an 80-acre patch of sweet clover and weed stalks, left unplowed from the previous year, which was located approximately two miles northeast of Pullman, Washington (Sec. 33, T. 15 N., R. 45 E.)

The first nest was situated 75 feet from a patch of Canadian Thistle (*Cirsium arvense*). It contained six eggs on April 18, when it was discovered by a student who was helping me census the area for partridges. The student had almost stepped on the nest before the female flew. Both the male and the female defended the nest very vigorously, uttering excited cries as they dived repeatedly within a few feet of the observers.

The second nest was found May 2, 400 yards from the first nest, and 30 feet from a Canadian Thistle patch. It contained one egg. On May 7, when the female was flushed, it contained three eggs. The female at this nest had no tail feathers and was easily distinguished from the female of Nest 1. The very light-colored male that had so vigorously defended Nest 1 also defended Nest 2. It made no difference which one I approached first nor how often I walked from one nest to the other: he always attacked with the same vigor, diving repeatedly as I came near either nest. Each female, however, was concerned only when her own nest was approached.

Both nests were kept under observation until May 7, when some students shot the female of Nest 1. After this female had been killed, the male did not protest my trespassing on the area around Nest 1, but he continued to protect the remaining female and nest until May 11, when both he and the female were discovered dead, probably shot by students.

At no time was there observed another male Marsh Hawk in the vicinity that took any interest whatever in either nest.—CHARLES F. YOCOM, *Department of Zoology, State College of Washington, Pullman, Washington.*

Flight of a hunting Marsh Hawk.—At about 10:30 A.M. on December 27, 1943, I was driving northward towards Defiance (Defiance County, Ohio) when I saw an adult male Marsh Hawk (*Circus hudsonius*) rise from a field and begin flying in a line with my car. It continued for 2⅒ miles in the direction I was going, thus enabling me to make the following observations on the correlation of speed and type of flight with kind of hunting territory covered.

The hawk's flight speed was: over plowed fields or fields of shocked corn, between 30 and 35 m.p.h.; over short-grass pastures, between 25 and 32 (usually about 27) m.p.h.; over wheat-stubble fields, between 20 and 25 m.p.h.; over weedy or fallow fields (where chances of obtaining food would presumably be best), between 12 and 18 m.p.h. The flight, over plowed fields, was straight, and over stubble fields somewhat zigzag; over weedy or fallow fields, the hawk zigzagged across a path about 75 feet wide. Because of this beating back and forth, the actual speed of flight over weedy or fallow fields would be greater than the 12 to 18 m.p.h. recorded by the speedometer of the car, which was following a straight course. The average speed for the 2⅒-mile stretch was 23 m.p.h. The hawk was flying at heights between 5 and 30 (usually about 20) feet above the ground, except on one occasion, when it described a small circle and came to within 2 feet of the ground to look over something which had attracted it. At the end of the flight, the hawk made an unsuccessful pounce for prey, rose, and then flew off in a westerly direction.

The hawk's flight was north by west, the wind direction west by south (therefore from the bird's left, and at a 90° angle). Wind velocity was less than 5 m.p.h., air temperature, 35° F. Fog made visibility poor—objects at a distance of less than half a mile disappearing from my view. The ground was not frozen and was free of snow.—MILTON B. TRAUTMAN, *F. T. Stone Laboratory, Put-in-Bay, Ohio.*

Knot in Auglaize County, Ohio.—During the morning of September 10, 1943, a group of five Knots (*Calidris canutus rufus*) flew into the State Fish Farm from Lake St. Marys, Auglaize County, Ohio. Since their wariness prevented close observation, one was shot for identification. The skin is now in the Ohio State Museum at Columbus. My search through the literature has revealed only two other records for this species from the central portion of Ohio: Wheaton ("Birds of Ohio," 1882: 478) recorded it from the Licking Reservoir, Buckeye Lake, May 27, 1878; and Blincoe (*Auk*, 48, 1931: 596) noted it at the lake at Englewood dam, Montgomery County, August 17, 1927.—CLARENCE F. CLARK, *Ohio Division of Conservation and Natural Resources, St. Marys, Ohio.*

Unusual records for north central Oklahoma.—The following unusual records were made at the Lake Carl Blackwell Project in Payne County, Oklahoma, in 1942.

Whistling Swan, *Cygnus columbianus.* Two were seen resting on Lake Carl Blackwell on November 11, and they permitted a close approach in a rowboat. This species is seldom recorded from Oklahoma.

White-winged Scoter, *Melanitta deglandi.* An immature male was seen at Lake Carl Blackwell on June 2. I approached in a motor boat to within 30 feet of the swimming bird before it took flight. I saw all of the field marks clearly with an 8X binocular. Apparently this is the first record for the species in Oklahoma.

Sanderling, *Crocethia alba.* I saw a Sanderling several times during the period August 8 to 21. This species has been recorded on several occasions in western Oklahoma, but I am not aware of any previous record for the central or eastern part of the state.

Forster's Tern, *Sterna forsteri.* A single bird was feeding with a flock of Black Terns over the fish culture ponds on May 23. Its peculiar flat note and characteristic wing and tail color were conspicuously different from the call and markings of the Common Tern. Apparently the Forster's Tern has not been recorded before in Oklahoma.

Black-capped Vireo, *Vireo atricapillus.* A male was singing vigorously on May 20 in a patch of black jack oak. This vireo is rare throughout the state and has not been recorded previously in the Stillwater area.—F. M. BAUMGARTNER, *Department of Entomology, Oklahoma A. and M. College, Stillwater, Oklahoma.*

An escaped Magpie at Madison, Wisconsin.—A male Magpie (*Pica pica hudsonia*) was shot from the top of an oak tree near Second Point on Lake Mendota, May 7, 1944. When examination showed that the tips of the upper rectrices were worn away, I became suspicious and called the Vilas Park Zoo (about two miles south of Second Point). I learned that they had received a shipment of 12 Magpies from Montana last winter (1943–44). Seven of the birds died; the other five escaped from their enclosure on April 28 (1944).

There remain, then (assuming survival), four escaped birds, which will be in fresh normal plumage after the autumn molt. For some time thereafter, the origin of any Magpie taken within any considerable radius of Madison will be questionable. Magpies have in the past been collected as far east as Virginia, but the incident of escaped birds reported here, indicates a need for caution in accepting these as records of natural occurrence.—A. W. SCHORGER, *168 N. Prospect Avenue, Madison, Wisconsin.*

All-day record of an incubating Robin.—A female Robin (*Turdus migratorius*) started to build her nest in a leafless elm in full sight of my window on March 23, 1938, adding a little material to the nest almost every day until April 7, when she began to work more steadily. Two days later she had to search about considerably for lining material, since everything, including the nest, was covered with snow. The first egg was laid April 13, and incubation started the following day. On April 24, I watched the nest from 5:22 A.M. till 7:20 P.M.; the day was clear with temperatures ranging from 56° to 72° F. The Robin left the nest 32 times, her periods off the nest ranging from one to 10 minutes, and averaging 5.6 minutes; the periods on the nest ranged from 6 to 45 minutes and averaged 20.6 minutes. She changed her position on the nest 70 times and turned the eggs 22 times. The male came to the nest 16 times, often coming immediately after his mate had left; he spent a total of 68 minutes at the nest.

This female left the nest twice as many times per day as the female Robin I observed in 1935 (*Wils. Bull.*, 51, 1939: 157–169), which left 10 to 19 times a day (the average of 16 all-day records being 16.3). The percentage of daylight hours on the nest were, however, equivalent—79 per cent in this record of 1938 (14 hours observation), and 80 per cent in 1935 (37 hours observation). WILLIAM EDWARD SCHANTZ, *1532 Aberdeen Avenue, Columbus, Ohio.*

EDITORIAL

The frontispiece of this *Bulletin* is the first published photograph of the Panama Ant-thrush (*Formicarius analis panamensis*), taken by Howard H. Cleaves, in the jungles of Barro Colorado Island, at the first known nest of this subspecies. In 1908, George K. Cherrie wrote that the related form on Trinidad nested in holes in trees, but he apparently published no further details. (A 1910 record of a completely different type of nest ascribed to the Costa Rican representative of the species is probably a case of mistaken identity.)

Because of the request from Washington that conventions not directly connected with the war effort be canceled, the officers of the Wilson Ornithological Club have abandoned plans for a 1944 annual meeting of all members. Since many matters of business have accumulated which cannot be handled effectively by mail, President Kendeigh has called a meeting of the members of the Council and the Chairmen of the standing committees. The meeting will be held August 11 and 12, at the F. T. Stone Laboratory of Ohio State University, at Put-in-Bay, on the invitation of Thomas H. Langlois, Director of the Laboratory. Arrangements are in charge of our Treasurer, Milton B. Trautman, who is Research Associate of the Laboratory. Members are asked to write to the Secretary of the Club, or to the Treasurer, on any matter of business which they would like to have brought before the meeting.

OBITUARY

Charles E. Hellmayr, outstanding authority on the classification and distribution of neotropical birds, died February 24, 1944 in Switzerland at the age of sixty-six. After acquiring an extraordinarily complete knowledge of the bird collections of Europe, he came to Chicago in 1922, as Associate Curator of Birds in Field Museum of Natural History, to complete the monumental series of volumes on "The Birds of the Americas" begun by Charles B. Cory. Ten more volumes have been published since, and the manuscript of the remaining parts is being held in Switzerland until war conditions permit sending it to this country.

Dayton Stoner, New York State Zoologist, died May 8, 1944, in Albany. He was born in Iowa and did his early ornithological work there; later he worked in the Fiji Islands, New Zealand, and the West Indies. He was best known among ornithologists for his series of detailed studies of the Bank Swallow. He had been an active member of the Wilson Ornithological Club since 1912.

William E. Ritter, noted biologist and philosopher, died January 10, 1944, in his eighty-eighth year. Fortunately for us, birds were among his many and varied interests, and in 1938 he published a remarkable book on the California Woodpecker.

Ornithological News

The Audubon Society of Western Pennsylvania has issued the first number of a new ornithological journal, "The Ruffed Grouse," edited by E. H. McClelland. The cover design was drawn by Andrey Avinoff, Director of Carnegie Museum.

Joseph J. Hickey, now engaged in war research at the University of Chicago, has been awarded a post-war Guggenheim Fellowship for a study of bird migration and population, based on the bird-banding files in Washington.

ORNITHOLOGICAL LITERATURE

ALASKA BIRD TRAILS. By Herbert Brandt. Illustrated by Major Allan Brooks and others. Bird Research Foundation, Cleveland, Ohio, 1943: 7½ × 9¾ in. xviii + 464 pp. $10.00.

"Alaska Bird Trails" is the detailed story of a five-man ornithological expedition which set out from Fairbanks, Alaska, on March 20, 1924; made its way by dog-sled over the Alaska and Kuskokwim ranges by way of Nenana, Lake Minchumina, McGrath, Iditarod, Flat, Holy Cross, and Mountain Village, to the mouth of Hooper Bay—an 850-mile trip requiring 40 days; and surveyed the bird-life of that region for several weeks. The author, who had organized and led the party, left Hooper Bay on June 26, returning to Nenana by boat, while the others (H. B. Conover, O. J. Murie, Frank Dufresne and Jack Warwick) remained there to continue collecting specimens and banding waterfowl. A vast amount of work was accomplished. Splendid collections were brought back, numerous fine photographs were made, and, best of all, a careful diary was kept. Mr. Brandt's book is based largely on his diary—and a very beautiful, very readable book it is.

What the reader will note instantly in "Alaska Bird Trails," and not soon forget, is its enthusiasm. Its author is, in the best sense of the phrase, a lover of nature. The beauty of birds stirs him deeply. He is thrilled by their color, their songs, their behavior, their habitat. Since he is especially interested in their nesting habits, he feels that he does not really know them until he has found their eggs, watched them brooding, examined their newly-hatched young. His book bubbles and runs over with the high joy of discovery, and so vivid is his account that we find ourselves marching back and forth across the tundra with him, hunting Godwit nests in the rain, flushing Steller's Eiders from their down-cradled eggs, and watching Savannah Sparrows run off like mice through the short grass. It is good to read a book of this sort now and then—for there is something youthful and invigorating about it. Specimens are mentioned now and then, of course, but these are far from any stale-aired museum, and what we feel as we move from page to page is fresh wind from the sea, soft moss underfoot, and firm, smooth-shelled eggs in our hands.

Since many of the common birds of the region are little known, Mr. Brandt's graphic accounts of them are a welcome contribution. Of special interest is what he reports concerning the Steller's and Spectacled Eiders, the Pacific Godwit, Black Turnstone, Western Sandpiper, and Alaska Yellow Wagtail. His comparison of the behavior of various shorebirds at their nests is particularly good (pp. 298-300), and his descriptions of the downy young of such species as the Black Turnstone, Emperor Goose, Long-billed Dowitcher, and Western Sandpiper merit special mention. Two detailed color-plates, by Edwin R. Kalmbach, illustrate the natal plumages of these and four other little-known water birds.

An appendix of more than a hundred pages is devoted to an annotated list of the species recorded by the expedition. Here data pertaining to specimens collected are so presented as to make it possible for a taxonomist or student of molts and plumage-sequences to ascertain exactly what material was preserved; problems of distribution are discussed; and many facts concerning nests mentioned in the narrative part of the book are enlarged upon. Eggs are described in great detail.

Throughout the narrative the common bird-names are somewhat confusing. Thus, when we come upon the name 'Alaska Jay' we wonder momentarily whether the bird belongs to the genus *Perisoreus* or *Cyanocitta*. Had the bird been called the 'Alaska Whiskey Jack,' or, better still, simply the 'Whiskey Jack' or 'Canada Jay,' we would have known instantly what species was referred to. Similarly, the name 'Alaska Ptarmigan' is misleading. 'Willow Ptarmigan' would have been better. The name 'Eastern Snow Bunting' is inadequate, if not downright inaccurate in that (a) it implies a western or Alaskan race of *Plectrophenax*

nivalis (McKay's Snow Bunting is given full specific rank by many authors); and (b) it wholly fails to take into account the Old World distribution of the species. Such names as 'Siberian Rough-legged Hawk' and 'Pacific Black-bellied Plover' are ponderous and of doubtful value, first because the author devotes very little space to discussion of geographical races or of any species' over-all distribution, as such, and second because some of these geographical races are of very dubious validity. Anyone who is eagerly reading for facts about the behavior of Alaska birds, or following the fortunes of an expedition, does not want to find his thinking muddled by nomenclatural surprises. The place for long, complex trinomials is the appendix.

The A.O.U. Check-List is, at least to some extent, to blame for these unsatisfactory common names. In future editions of this widely-used work it is to be fervently hoped that the Committee will be content with common names for full species only, or find common names for the subspecies which will take into account *all facts* concerning the species as a whole. 'Eastern Snow Bunting' and 'Eastern Goshawk' are excellent examples of common names which deny the species any Old World distribution whatsoever. American ornithologists will win for themselves, and deserve, a reputation for provincialism if this unfortunate custom continues.

Most interesting is Mr. Brandt's discussion of the specific distinctness of the Cackling Goose and Lesser Canada Goose. Personally I agree with him wholeheartedly; but my experience with Richardson's Goose (*Branta canadensis hutchinsi*) on Southampton Island, where this exceedingly small race nested almost side by side with the rarer *Branta canadensis leucopareia*, leads me to feel that failure of the two forms to mate together does not necessarily constitute "good evidence that they are specifically distinct" (p. 276). I should call the Richardson's Goose and the Lesser Canada Goose only subspecifically distinct. Yet on Southampton Island they certainly summer together.

The color-plates in "Alaska Bird Trails" are a delight to the eye. Those by Major Brooks are splendid examples of his work, and they have been exceptionally well reproduced. The full-page photograhs are artistic and interesting, that of the Snowy Owl at its nest (opp. p. 128) being especially exciting.

All in all, "Alaska Bird Trails" is a most timely work. Although it does not cover the whole territory of Alaska it will serve as a guide to the ornithology of this region until a more complete work appears, and its glowing account will lead many an ornithologist of future years to travel northward to tackle the unsolved problems of that glorious wilderness north of the Yukon.—George Miksch Sutton.

The Ecology and Management of the American Woodcock. By Howard L. Mendall and Clarence M. Aldous. Maine Cooperative Wildlife Research Unit, Orono, Maine, 1943: 9 x 6 in., x + 201 pp., 11 figs., 14 pls., 19 tables.

Since the publication of my treatise on the life history of the American Woodcock (Pettingill, *Mem. Boston Soc. Nat. Hist.*, 9, 1936:167–391), which was based chiefly on investigations in New York, two important papers have appeared dealing with activities centering about the Woodcock's singing fields in Illinois (Pitelka, *Wils. Bull.*, 55, 1943:88–114) and in Pennsylvania (Norris et al., *Jour. Wildl. Manag.*, 4, 1940:8–14). This new treatise is based on further investigation of the Woodcock's life history (although concerned primarily with matters that have a direct bearing on management). The bulk of the text consists, in fact, of life-history data and discussions of such topics as distribution and migration, food and feeding-habits, and cover-preferences. Only 60 pages deal with management as such.

Fortunately Mendall and Aldous were able to carry on their study in eastern Maine, which undoubtedly has the largest breeding population of Woodcocks in the United States. The results obtained, therefore, warrant some comparison with

the Pitelka and the Norris investigations, which were conducted among relatively small populations.

Mendall and Aldous agree with my concept of the breeding territory as consisting of two parts—the male domain and the female nesting territory. The former is divided into a diurnal territory (the male's chief abode) and a singing field (locality of his courtship performances), and "tendencies were shown for the singing grounds to be fairly close to both the diurnal territories and the nesting territories" (p. 74). Active defense of the singing fields was commonly observed. No evidence was found that the female nesting territory is, or is not, a defended area, but numerous instances were recorded of several males remaining on the diurnal territory in apparent harmony. It thus appears that where there is a large Woodcock population, territories are crowded, so that competition is noticeable on the singing fields though competition for nesting and diurnal territories does not seem to exist. In the light of these observations it is perhaps doubtful whether nesting and diurnal "territories" are indeed *territories* as defined by Nice and others (i.e. defended areas). Mendall and Aldous find, as did Pitelka, that the *cackling* note is given only by the male in the presence of another male, or males, as a form of intimidation; it was not found to be associated with the mating act. They doubt whether the females ever utter the *peent* calls. Fewer males are reported during the morning display periods than during the evening. In New York I found both periods equally well used, and I am under the impression that the activities of the morning periods were more vigorous. It is the opinion of Mendall and Aldous that the Woodcock is monogamous. However, monogamy might be characteristic of the population of one area, though not of the species as a whole; the type of territoriality shown by the male is conducive to polygamy in a degree equal to the type of territoriality (i.e. *crowing grounds*) in certain gallinaceous birds and I feel that polygamy will be found to be characteristic of at least some populations. Mendall and Aldous present new circumstantial evidence to support my statement (1936) that incubation "is carried on usually, if not entirely, by the female."

Careful studies of nesting conditions showed slight egg loss and low juvenile mortality. For a ground-incubating species, the figures are remarkable: successful hatches were recorded in 67.2 per cent of the 125 nests under observation; the rate of juvenile mortality did not exceed 10 per cent.

As in all investigations of well-known game birds, much ill-founded lore pertaining to the Woodcock has again been put to the test and "exposed": females were not observed to carry their young even though family groups were watched more than 400 times; there was no evidence whatever that the Woodcock raises more than one brood per year; and no facts were found to support the frequently repeated statement that the Woodcock is able to prevent the issuance of scent while incubating.

In the part of the paper preceding the life history section noteworthy information is given on distribution and migration. It is gratifying to learn that there is an unusually large breeding population on Prince Edward Island, where the Woodcock has always been considered uncommon. The bulk of the winter Woodcock population is now known to be restricted to the Lower Mississippi Valley (the northern three-fourths of Louisiana and a few localities of western Mississippi and extreme southeastern Arkansas). Only recently the bird was thought to be rather evenly distributed throughout the southeastern United States during the winter. Fairly direct flight lines seem to be established between the lower Mississippi wintering grounds and all northern points of the Woodcock's breeding range except in the Northern Atlantic States, where there is a distinct coastal route as far south as Cape May, New Jersey, and Cape Charles, Virginia, and then (supposedly) a cross-over from these coastal points to the Lower Mississippi.

In the last section of the paper, which is devoted to management, the authors discuss quite thoroughly the various techniques employed in carrying out their investigations. Of the census methods used, they recommend a yearly count of occupied singing fields as yielding the best index of breed' populations. The regularity of display in the evening and morning allows an accurate estimate of all males and (unless the Woodcock is polygamous) of all females in a given area. The best method to use in banding Woodcock is to capture juveniles after the broods of fledglings have been found by a trained dog. By this method Mendall and Aldous banded 485 juveniles in six years. They advise against the use of dogs for finding nests because, in their experience, a nesting Woodcock has greater fear of a dog than of man and is likely to desert the nest after being flushed by a dog.

Mendall and Aldous conclude that there are "but two limiting factors which are of very great importance to the Woodcock and which at the same time are readily controllable by man," namely, hunting and cover deficiencies. They suggest several possible counteractants. Among these is the creation, by artificial means, of singing fields. This has been experimented with successfully in Maine, but one wonders whether the great expense involved in the creation and yearly maintenance of singing fields would be justified by the results, since each singing field would be occupied by but one male.

This publication is an extensive contribution to our knowledge of an important game bird and will serve to guide those persons whose responsibility it is to effect a much-needed management program. It is well-organized, attractively published, and laudably free of typographical errors. There are numerous photographic illustrations (though many of these are not accredited). A bibliography concludes the work. There is, unfortunately, no index.—Olin Sewall Pettingill, Jr.

CUBAN ORNITHOLOGY. By Thomas Barbour. Memoirs of the Nuttall Ornithological Club, No. 9, August, 1943, 144 pp., 2 pls. Publ. by the Club, Cambridge, Massachusetts. $4.00.

This useful volume is a revision of Dr. Barbour's "Birds of Cuba," published in June, 1923, as Number 6 in this same series of Memoirs. The present work is completely reset, in a larger font of type, and includes much new material, so that in the opinion of this reviewer the author has acted wisely in giving the book a new title as an aid to students who need to cite passages in it. The original introduction has been omitted for a new one that outlines the influence of the well-known scientists, Brother Léon and Dr. Carlos de la Torre, in training students who have been active in furthering studies in the natural history of Cuba, and includes a summary of modern trends in conservation that have led to Cuba's participation in a convention for nature protection throughout the Americas and the establishment of reserves for the preservation of the fauna and flora of the Republic.

The annotated list that forms the body of the book covers 297 forms, an increase of 24 over the 273 listed in the earlier volume. The new material includes data obtained from banding records of migrants from the North, additional information on occurrences and habits, and discussion of the validity of some of the forms.

One of the principal additions is in the form of notes made in the gardens and grounds at the Atkins Institution of the Arnold Arboretum near Soledad, Santa Clara Province, which the author visited annually, and where he was instrumental in promoting protection for the birds.

It is interesting to note the recent change in status of the Herring Gull from rare to abundant, due apparently to actual increase of these birds in the North; equally of interest are the author's notes on the Florida Burrowing Owl at Grand Bahama with a reference to Bond's published record of the first specimen

reported from Cuba. Reading through the pages brings again to mind how little we know of the breeding of many West Indian birds; e.g., the eggs of the Little Pine Crow (the *Cao Pinolero* of the Cuban countryman) are said to be still unknown though it should not be difficult to discover the nest. (Bond's description in "Birds of the West Indies," 1936, p. 269, apparently refers to the eggs of *Corvus palmarum palmarum* of Hispaniola.)

To the student of the ornithology of Cuba this revised work will be invaluable, and it may be added that bird lovers in general will find this an interesting book because of the many fascinating passages in the graphic style that seems to flow so easily from Dr. Barbour's mind and pen.—Alexander Wetmore.

A Preliminary Life History Study of the Florida Jay, *Cyanocitta c. coerulescens*. By Dean Amadon. (Results of the Archbold Expedition No. 50). *Amer. Mus. Novit. No.* 1252. Jan. 24, 1944. 22 pp.

If proof were needed to demonstrate that opportunities for adding to our knowledge of birds exist all about us and only await our serious attention, this paper would serve to carry the point. Amadon spent about a month at Lake Placid, Florida, picked a bird quite new to his own field experience, and in that short space of time succeeded in adding more to what is known of its habits than one would have thought possible.

Although a denizen of bushy thickets, the Florida Jay was found to be bold and easily studied. It buries food by thrusting it beneath the sand and then placing dead leaves or other objects over the place. Later, when searching for buried food, the bird swings its head from side to side, throwing the sand to either side with the bill. Courtship feeding is a character of the species, and is continued throughout incubation and even after the young hatch out. Both sexes participate in nest-building, but only the female incubates. Incubation begins with the laying of the first egg. Both sexes help feed the young, but only the female broods. The number of feedings given the young birds increased from 2–3 times an hour during the first week to 5–12 by the second week.

That the author is candid about the indefiniteness of some of his observations is refreshing and gives all the more reliability to those about which he is more explicit. Thus, in writing of a "whisper song" given by both sexes, he states that it "seems to express either physical well being or mild perplexity." His field techniques are well planned and well carried out; the paper should be useful to others for these alone.—Herbert Friedmann.

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NEW LIFE MEMBER

OSCAR M. ROOT graduated from Harvard University and has done graduate work at the University of Michigan and Woods Hole. He is a very active bird bander and is a member of the Council of the Northeastern Bird-banding Association. Since 1933 he has taught biology and mathematics at Brooks School, Andover, Massachusetts. His particular interests have been natural history, conservation, and ornithology, with special emphasis on ecology, distribution, and populations of birds.

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